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STUDIES ON PHALAENOPSIS, III

P. EQUESTRIS (SCHAUER) REICHB. F., P. LINDENII LOHER P. LUEDDEMANNIANA REICHB. F., P. MARIAE BURB. AND P. MICHOLITZII ROLFE

By EDUARDO QUISUMBING

Chief, Natural History Museum Division
Department of Agriculture and Commerce, Manila

FIVE PLATES

This paper is the third series on studies on Philippine species of *Phalaenopsis*,[1] under the sections *Zebrinæ* and *Stauroglottis*. It comprises the following species: *P. equestris* (Schauer) Reichb. f., *P. Lindenii* Loher, *P. Lueddemanniana* Reichb. f., *P. Mariae* Burb., and *P. Micholitzii* Rolfe. Many years of study of Philippine orchids gave me an opportunity to restudy the above species in their living conditions, particularly the Reichenbach's species. This paper includes also a brief discussion of excluded and doubtful species. The following are excluded for two reasons: (*a*) species which were erroneously credited to the Philippines, and (*b*) species which have not been seen by the author.

Various sections of *Phalaenopsis* have been proposed. Pfitzer[2] proposed five sections, of which three are represented in the Philippines (*Euphalaenopsis, Zebrinæ,* and *Stauroglottis*). The two other sections (*Proboscidioides* and *Antenniferæ*) are also represented but by introduced species.

Rolfe[3] has proposed the sixth section (*Esmeralda*), which is represented in the Philippines by introduced species, and which is no different from Pfitzer's *Antenniferæ*.

[1] Previous papers. I: Phil. Jour. Sci. 74 (1941) 175–185, *2 plates;* II: Phil. Jour. Sci. 76 (1941) 81–97, *9 plates.*

[2] Pfitzer, in Engl. & Prantl, Pflanzenfam. II 6 (1889) 212.

[3] In Veitch, Man. Orch. Pl. pt. 7 (1891) 17.

Key to the sections of Phalaenopsis.

1. Petals much broader than sepals and contracted at the base.
   2. Middle lobe of lip with two cirrhi or two divaricate lobes at the apex; without proboscislike rostellum.................................. *Euphalaenopsis.*[4]
   2. Middle lobe of lip without apical appendages; with proboscislike rostellum .... *Proboscidioides.*[5]
1. Petals equal to, rarely smaller than, sepals; middle lobe of lip entire, without apical appendages and without proboscislike rostellum.
   2. Claw of lip without appendages.
      3. Middle of lobe of lip ovate; upper surface smooth.... *Stauroglottis.*[6]
      3. Middle lobe of lip oblong; upper surface with a crest of hairs. *Zebrinae.*[7]
   2. Claw of the lip with a pair of slender appendages........ *Antenniferæ.*[8]

Section STAUROGLOTTIS Schauer

Sepalen und Petalen siemlich gleich, meist 1 farbig, Endlappen der Lippe ungeteilt, quer verbreitert, oft am Grunde mit zahlreichen fadigen Forstsatzen, z. B. *Ph. Parishii* Rchb. f. aus Birma.[9]

Key to the Philippine species.

1. Leaves green; middle lobe of lip ovate............................. 8. *P. equestris.*
2. Leaves marbled and barred with silvery gray; middle lobe of lip suborbicular .... 9. *P. Lindenii.*

PHALAENOPSIS EQUESTRIS (Schauer) Reichb f. Plate 1, fig. 1; Plate 2.

Phalaenopsis equestris (Schauer) REICHB. f. in Linnæa 22 (1849) 864; LINDL. in Paxt. Flow. Gar. 2 (1852) 174; REICHB. f. in Walp. Ann. 3 (1852) 562; 6 (1864) 860; MIQ., Fl. Ind. Bat. 3 (1859) 690; REICHB. f. in Hamb. Gartenz. 16 (1860) 116; DUCHARTRE in Jour. Soc. Imp. et Centr. Hort. Par. 6 (1860) 869, 8 (1862) 727; REICHB. f., Xen. Orch. 2 (1862) 4; NAVES, Novis App. (1882) 242; AMES, Orch. 2 (1908) 229, 5 (1915) 216, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 413; SCHLECHTER, Die Orchideen (1927) 537.

[4] Section proposed by Bentham. Philippine species under this section published in Phil. Jour. Sci. 74 (1941) 175–187, two plates; Phil. Jour. Sci. (1941).

[5] Section proposed by Pfitzer, in Engl. & Prantl, Pflanzenfam. II 6 (1889) 212; typified by *P. Lowi* Reichb. f.

[6] Section proposed by Schauer [*see* Engl. & Prantl. Pflanzenfam. II 6 (1889) 212]; typified by *P. Parishii* Reichb. f., and by *P. equestris* (Schauer) Reichb. f.

[7] Section proposed by Pfitzer, loc. cit.; typified by *P. Lueddemanniana* Reichb. f.

[8] Section proposed by Pfitzer, in 1889, which was based on *P. antinnefera* Reichb. f. which is now made a synonym of *P. esmeralda* Reichb. f. (1874). According to Veitch [Man. Orch. Pl. pt. 7 (1891) 17] Rolfe proposed the section *Esmeralda* for species with a pair of slender appendages in the claw of the lip. Section *Esmeralda* was, therefore, proposed 17 years after Pfitzer had proposed the section *Antenniferæ.*

[9] Pfitzer, loc. cit. 212.

Stauroglottis equestris SCHAUER in Nov. Act. Acad. Nat. Cur. 19 Suppl. 1 (1843) 432.

Phalaenopsis rosea LINDL. in Gard. Cron. (1848) 671, *text cut;* Paxt. Mag. Bot. 16 (1849) 60, 189, *text cut;* LINDL. in Paxt. Flow. Gard. 2 (1852) 173, *t. 72;* REICHB. f. in Bot. Zeit. 10 (1852) 673; MOORE, Ill. Orch. Pl. (1857) Phalaen. 7; HOOK. in Bot. Mag. 86 (1860) *t. 2512;* LEM. in Jard. Fleur. 3 (1853) *t. 283,* in Ill. Hort. 10 (1863) Misc. 11; VAN HOUTTE in Fl. des Serres 16 (1866) t. *1645;* JENNINGS, Orch. (1875) *t. 27;* BURB. in The Garden 22 (1822) 119 (excl. var.); VIDAL, Phan. Cuming. Philip. (1885) 150, Rev. Pl. Vasc. Filip. (1886) 270; ROLFE in Gard. Chron. II 26 (1886) 276; WARNER & WILL., Orch. Alb. 6 (1887) *t. 268;* VEITCH, Man. Orch. Pl. pt. 7 (1891) 34; AMES, Orch. 1 (1905) 102.

Phalaenopsis rosea Lindl. var. *leucaspis* ROLFE in Gard. Chron. 26 (1886) 276; VEITCH, Man. Orch. Pl. pt. 7 (1891) 34.

Phalaenopsis esmeralda COGN. in Dict. Icon. Orch. (1898) Phalaen. *t. 3,* non Reichb. f.

Phalaenopsis equestris (Schauer) Reichb. f. var. *leucaspis* REICHB. f. in Gard. Chron. II 15 (1881) 688, in l'Orchidoph. 1 (1881) 50; AMES, Orch. 2 (1908) 230.

Phalaenopsis equestris (Schauer) Reichb. f. var. *leucotanthe* REICHB. f. in l'Orchidoph. 3 (1883) 490; AMES, Orch. 2 (1908) 230; AMES & QUIS. in Phil. Jour. Sci. 52 (1933) 454, *t. 2, figs. 7–8; t. 11, fig. 2.*

The original description reads as follows:

Stems very short. Roots greenish or purplish, fleshy. Leaves fleshy, light green or dull green, 2 to 4, oblong, elliptic-oblong or oblong-obovate, usually 10 to 15 cm, up to 21 cm long, 3 to 5 cm wide, the apex recurved, subacute or obtuse, slightly narrowed to the base. Scapes lateral, arising from between the lower leaves, simple or branched, 15 to 47 cm long, few- or many-flowered; the rachis purplish, terete. Flowers odorless, 2.5 to 4 cm across. Pedicellate ovary slender, white with pale green at the base, 1.5 to 1.9 cm long. Sepals and petals spreading, nearly equal in size and shape, white flushed with rose purple at the center and especially near the base. Sepals oblong-lanceolate, 13 to 14 mm long, 6 to 7 mm wide, the apex obtuse, and rather broad at the base. Petals narrowly rhomboidal, obtuse, 13 to 14 mm long, 8 to 9 mm wide, somewhat constricted at the base. Labellum tri-lobed; middle lobe ovate, acute or briefly acuminate, fleshy, entire, without apical appendages, with a depression at the middle, 11 to 12 mm long, 8 to 9 mm wide, rose purple, darker purple at the tip and flushed with little orange at the base, the margins often reflexed; lateral lobes small, linear-spathulate, oblique, recurved, 6 to 8 mm long, 2 to 2.5 mm wide at the widest portion, white flushed with pale rose purple, often streaked with purple lines within. Callus fleshy, subquadrate, white, or yellow dotted with flame scarlet or morocco red. Column terete, curved slightly, white with rose purple above, 8 to 9 mm long, the beak long and white. Anther cap broadly ovate. Pollinia 2, ellipsoid, cream-colored. Capsules linear, 6 to 7 cm long, excluding the pedicels (1.5 to 2 cm long), 0.5 to 0.8 cm in diameter.

PHILIPPINES, without locality, *Cuming 2051* (in herb. Brit. Mus.; specimen not seen). BATAN ISLAND, Mt. Iraya, *Bur. Sci. 80793 Ramos.* LUZON, Ilocos Norte Province, Bangui, *Bur. Sci. 7736, 27618 Ramos;* without locality, *Lyon 3401:* Isabela Province, Palanan Bay, *Bur. Sci. 21168 Escritor:* Bataan Province, Mt. Mariveles, *Elmer 6861, Williams 376, For. Bur. 2280 Meyer, Merrill 3849;* Lamao, *Bur. Sci. 3043, 5605 Cuzner, Bur. Sci. 1895 Foxworthy:* Rizal Province, without locality, *Loher 3532;* Jalajala, *Bur. Sci. 11931 Robinson & Ramos;* Antipolo, *Bur. Sci. 49637 Ramos:* Manila, *Bur. Sci. 85571 Quisumbing* (living plants from Rizal Province, typical of var. *leucotanthe* Reichb. f.): Laguna Province, Santa Maria–Mabitac, *For. Bur. 8906 Curran:* Tayabas Province, Mt. Tulaog, *Ramos & Edaño, s. n. 1917;* Casiguran, *Phil. Nat. Herb. 3230 Vanoverbergh;* Mt. Pular, *Bur. Sci. 19408 Ramos;* Guinayangan, *Bur. Sci. 20775 Escritor:* Camarines Sur Province, without locality, *For. Bur. 22628 Alvarez, For. Bur. 12283 Curran:* Albay Province, Mayon Volcano, *Bur. Sci. 2381 Mearns.* BOHOL, *Bur. Sci. 1235 McGregor.* MINDANAO, Davao Province, Baganga, *Rev. R. F. Black 26;* Todaya, *Copeland 1228:* Lanao Province, Camp Keithley, *Clemens 5622.* CAMIGUIN ISLAND, Mambajao, *Elmer 14247.* The species have been reported also from the islands of Samar, Leyte, Negros, Cebu, and Panay; no records from Palawan or Mindoro. A common and widely distributed species, altitude from sea level to 300 meters. It is called in English "Rose colored Phalaenopsis," and locally "rosea." The plant flowers throughout the year, but more profusely during February to May. This species is peculiar like other *Phalaenopsis* in producing young plants on the old stems and old roots. Scapes need not be cut after flowering as from these old ones new branches are developed producing flowers. The species is endemic.

Two varieties have been recognized by Reichenbach f. (*leucaspis* and *leucotanthe*); *leucaspis* differing from the species in its smaller flowers and in having more deeply colored midlobe of the lip; and *leucotanthe* differing in the color of flowers being white. The differences being in color only, the two varieties have not been recognized in this paper.

Phalaenopsis equestris is a typical representative of the section *Stauroglottis.* The species is characterized by its light-green or dull-green leaves, some forms resembling those of *P. aphrodite.* The flowers are small, with petals and sepals with

practically the same color and shape, usually white, flushed with rose purple. The labellum is trilobed, with the middle lobe ovate, entire, and without appendages.

PHALAENOPSIS LINDENII Loher. Plate 1, fig. 1; Plate 4, figs. 1–9; Plate 5.

Phalaenopsis Lindenii LOHER in Jour. des Orch. 6 (1895) 103; Orchis 1 (1907) 82, *fig. 37;* ROLFE in Orch. Rev. 13 (1905) 230, 15 (1907) 296; AMES in Phil. Jour. Sci. 4 (1909) Bot. 599, Orch. 5 (1915) 217, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 414; G. WILSON in Orch. Rev. 30 (1922) 354.

The original description reads as follows:

Phalaenopsis Lindenii Loher.—Cette nouvelle espéce est dédicé á M. J. Linden par l'explorateur que la découverte, et qui en donne la déscription suivante:

Folia oblonga, albido-argentea, viridi-maculata; pedunculi purpurei, bracteis parvis, acutis; perigonii phylla exteriora et interiora subaequalia, obovata subclavata, oblusa, albida (versus nervum medium subrosea); labelli tripartiti lobi laterales subfalcati, oblongi-obtusi, versus basin interionem maculis aurantiacis, scatello vel callo bilobo aurantiaco maculato; lobus intermedius cordato-rotundatus breviter acuminatus, striis quinque purpureis, basi albidus, medio superiori amethystinus.

Cette espéce rappelle un peu par son feuillage le *P. Schilleriana* mais elle a les feuilles beaucoup plus étroites, á peu prés gladiolées; quant aux fleurs, elles se rapprochent beaucoup a celles du *P. rosea,* mas elles sont beaucoup plus grandes, presque doubles. En oulre, elle s'en distinguent par let coloris du labelle, qui a le lobe antérieur améthyste vif avec la base rose pale; cet organe est sensiblement arronde, briévement acuminé tandis que dans le *P. rosea* il a la forme d'un losange.

M. Loher remarque qu'aucun autre Phalaenopsis ne croit dans l'endroit ou se rencontre la nouvelle espéce.

Habit similar to *P. equestris.* Leaves oblanceolate or narrowly oblong-oblanceolate, subacute, 17.5 to 20 cm long, 2.5 to 4 cm wide, deep dull green, marbled and maculated with silvery gray above, purplish beneath (resembling somewhat thin leaves of *P. Schilleriana*). Scapes few-flowered, simple or branched, much longer than the leaves, 20 to 50 cm long. Flowers odorless, 3 to 3.5 cm across. Pedicellate ovary, slender, 2 to 3 cm long. Sepals and petals white, flushed with light rose purple, each marked with 5 to 7 defined purple lines. Dorsal sepal oblong-elliptic, obtuse, 14 to 15 cm long, 6 to 8 mm wide. Lateral sepals oblong-ovate, falcate, obtuse, 14 to 17 mm long, 7 to 9.5 mm wide. Petals obovate-spathulate, broadly obtuse, 13 to 15 mm long, 8 to 10 mm wide at the widest portion. Labellum trilobed; middle lobe suborbicular, apiculate, 10 to 12 mm long, 9 to 12 mm wide, mallow purple with 5 or 7 well-

defined radiating rhodamine purple lines, the base and apiculum white; lateral lobes narrowly oblong, subspathulate, dilated at the apex, obtuse, 7.5 to 9 mm long, 2.5 to 3 mm wide, white, flushed with phlox purple at the apex, and dotted with ferruginous at the base. Column terete, 7 to 9 mm long, white, the anterior surface rhodamine purple. Callus disc-shaped when spread out, white dotted with ferruginous. Anther cap broadly ovate. Pollinia two, ellipsoid.

LUZON, Benguet subprovince, Baguio, *For. Bur. 5121, 5122 Curran, Williams 1947 bis, Phil. Nat. Herb. 7984 Quisumbing.* The species is endemic. It occurs at higher altitudes. It flowers from March to August.

Phalaenopsis Lindenii is perhaps a natural hybrid between *P. equestris* and *P. Schilleriana.*

Rolfe[10] suspected it also to be a natural hybrid of the two species mentioned. The marbled and maculated leaves except size and shape suggest those of *P. Schilleriana,* though the leaves of this species are more delicate and thinner. The flowering habit is that of *P. equestris.* The general habit of growth, size of flowers, details of the flowers except the middle lobe of the lip suggest those of *P. equestris.* The absence of *P. Schilleriana* in regions where this species grows is rather weak argument in favor of the parentage of this species. It is, however, possible that *P. Schilleriana* may have existed in these regions where *P. Lindenii* now grows. We have a parallel case of *P. Schilleriana-Stuartiana* and *P. aphrodite* var. *Sanderiana* of Mindanao. Whether the species in question is a natural hybrid or not, it is conclusive that *P. Lindenii* is a distinct species. It is closely allied to *P. equestris,* differing markedly in its marbled and maculated leaves, and the shape of the middle lobe of the lip. It is not allied to *P. Schilleriana* because of the absence of apical appendages at the middle lobe of the lip. The species was dedicated to Mr. M. J. Linden.

Section ZEBRINAE Pfitzer

Sepalen und Petalen ziemlich gleich, meistens mit farbigen Querbändern auf hellem Grund, Endlappen der Lippe ungeteilt, länger als breit. Hierber *Ph. sumatrana* Korth. Rechb. f. aus Sumatra und *Ph. Luddemanniana* Rchb. f. von den Philippinen, beide oft gezogen, sowie *Ph. speciosa* Rchb. f. (Fig. 213 links).—PFITZER, loc. cit. 212.

Leaves green. Middle lobe of the lip longer than wide, the upper surface with a crest of hairs; petals and sepals barred.

[10] Orch. Rev. 13 (1905) 230.

Typified in the Philippines by *Phalaenopsis Lueddemanniana* Reichb. f.

Key to the Philippine species.

1. Labellum oblong or oblong-oblanceolate.
   2. Flowers 4 to 5 cm across; dorsal sepal oblong or oblong-elliptic, acute .... 10. *P. Lueddemanniana.*
   2. Flowers smaller, not more than 3 cm across; dorsal sepal narrowly oblong, obtuse .... 11. *P. Mariae.*
1. Labellum rhombic-spatulate .... 12. *P. Micholitzii.*

PHALAENOPSIS LUEDDEMANNIANA Reichb. f. Plate 1, figs. 3–6; Plate 3.

Phalaenopsis Lueddemanniana REICHB. f. in Bot. Zeit. **23** (1865) 146, in Gard. Chron. (1865) 434; MOORE in Flor. & Pomol. (1865) 257, *t. 254;* LEM. in Ill. Hort. **12** (1865) Misc. 31; EDIT. in Proc. Roy. Hort. Soc. **5** (1865) 137; OTTO in Hamb. Gartenz. **21** (1865) 470; G. B. in Belg. Hort. **15** (1865) 229; CARR. in Rev. Hort. **44** (1872) 390, *t.;* ROLFE in Gard. Chron. II **26** (1886) 277, in Lindenia **2** (1886) 95, *t. 94,* **8** (1892) 63, *t. 366;* VEITCH, Man. Orch. Pl. pt. 7 (1891) 30, *text cut;* COGN. in Dict. Icon. Orch. (1899) Phalaen. *t. 9;* AMES, Orch. **2** (1908) 230, **5** (1915) 217, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 415.

Phalaenopsis Lueddemanniana Reichb. f. var. *delicata* REICHB. f. in Gard. Chron. (1865) 434; BURB. in The Garden **22** (1882) 119; ROLFE in Gard. Chron. II **26** (1886) 277, in Lindenia **8** (1892) 63, sub *t. 366;* AMES, Orch. **2** (1908) 231.

Phalaenopsis Lueddemanii BOXALL ex Naves, Novis. App. (1882) 243, sphalm.

Phalaenopsis Lueddemanniana BATEM. in Bot. Mag. **91** (1865) *t. 5523,* Second Cent. Orch. Pl. (1867) *t, 133,* non Reichb. f.; VAN HOUTTE in Fl. des Serres **16** (1865) 53, *t. 1636.*

Phalaenopsis Lueddemanniana Reichb. f. subvar. *delicata* VEITCH, Man. Orch. Pl. pt. 7 (1891) 30.

Phalaenopsis Lueddemanniana Reichb. f. var. *hieroglyphica* REICHB. f. in Gard. Chron. III **2** (1887) 586; EDIT. in l'Orchidoph. **9** (1889) 197; ROLFE in Lindenia **8** (1892) 63, sub. *t. 366;* AMES, Orch. **2** (1908) 231.

Phalaenopsis Lueddemanniana Reichb. f. subvar. *hieroglyphica* VEITCH, Man. Orch. Pl. pt. 7 (1891) 31.

Phalaenopsis Lueddemanniana Reichb. f. var. *ochracea* REICHB. f. in Gard. Chron. (1865) 438; CARR. in Rev. Hort. **44** (1872) 391, *fig. A;* BURB. in The Garden **22** (1882) 119; ROLFE in Gard. Chron. II **26** (1886) 277, in Lindenia **8** (1892) 63, sub. *t. 366;* AMES, Orch. **2** (1908) 232.

Phalaenopsis Lueddemanniana Reichb. f. subvar. *ochracea* VEITCH, Man. Orch. Pl. pt. 7 (1891) 31.

Phalaenopsis Lueddemanniana Reichb. f. var. *pulchra* REICHB. f. in Gard. Chron. II **4** (1875) 36; BURB. in The Garden **22** (1882) 119; ROLFE in Gard. Chron. II **26** (1886) 277, in Lindenia **8** (1892) 64, sub. *t. 366;* AMES, Orch. **2** (1908) 232.

Phalaenopsis Lueddemanniana Reichb. f. subvar. *pulchra* VEITCH, Man. Orch. Pl. pt. 7 (1891) 31.

Phalaenopsis Lueddemanniana Reichb. f. var. *purpurea* AMES & QUIS. in Phil. Jour. Sci. 49 (1932) 494, *t. 2, 10, 24*.

Phalaenopsis Boxallii REICHB. f. in Gard. Chron. II 19 (1883) 274; ROLFE in Gard. Chron. II 26 (1886) 276; VEITCH, Man. Orch. Pl. pt. 7 (1891) 26; AMES, Orch. 5 (1915) 216, ex. Merr. Enum. Phil. Fl. Pl. 1 (1925) 413.

The original description reads as follows:

Phalaenopsis Lueddemanniana aff. *Ph. sumatranae* Korth. et Rchb. fil. (*zebrinae* Hort. Bog.), et *violaceae* Teism. et Binnd. sepalis tepalisque cuneato-oblongis acutis, labello tripartito, partitionibus lateralibus ligulatis, apice excisobidentatis, extus medio umbonato carinatis erectis, partitione media ab ungue angusto oblonga antice apice utrinque angulata, sen dentata, seu serrata, fornicata ante basin ac apice carinata, carinis nunc serratis, antice pilis circumdata, papulis seriatis as ligulis bifidis duabus a disco inter partitiones posticas in basin partitionis mediae, columna utrinque basi angulata.

Diese Art blünte zuerst bei Herrn Lüddemann in Paris (Boulevart des Gobelins), der sie von den Philippinen einführte. Sie ist eine sehr schöne Pflanze. Die Lippe und Säule sind amethystfarbig. Die Sepalen und Tepalen ebenso und mit vielen braunen Querbinden.

Ein herrliches Exemplar mit grossen zungigen Blättern und einem dreiblüthigen und einem einblüthigen Blüthenstiel sah ich bei Herrn Dr. Pattison in London, S. Johns Wood, 10. Cavendish road. Ferner sah ich die Pflanze in Blüthe bein Herrn Day, High Cross, Tottenham und in Knospen bei Herrn Low, Upper Clapton.

Auf alle Fälle ist sie eine glänzende Acquisition für unsere Gärten. Ich lasse dahin gestellt, ob nicht einmal Mittelformen sich zeigen werden, welche die Vereinigung mit den obengenannten zwei Arten nöthig machen, was indessen nicht sehr wahrscheinlich.—REICHB. F., Bot. Zeit. 23 (1865) 146.

Stems short. Roots greenish. Leaves 3 to 5, somewhat shining, fleshy but not as fleshy as *P. amabilis*, pale green or yellowish green, oblanceolate or oblong-oblanceolate, 10 to 15 cm long, in some forms up to 33 cm long, 3.5 to 5 cm wide, in some cases up to 7.5 cm wide. Scape few-flowered, usually unbranched, 6.5 to 10 cm long, up to 30 cm sometimes; peduncles greenish. Flowers usually odorless, in some forms particularly the Sorsogon form, fragrant, 4 to 5 cm across. Pedicellate ovary slender, pale green, 2 to 3 cm long. Sepals and petals spreading, white or yellowish background, sometimes suffused with phlox purple, and marked with transverse bars of amethyst purple (in some forms with ferruginous bars). Dorsal sepal oblong or oblong-elliptic, acute, 2 to 3 cm long, 1 to 1.5 cm wide. Lateral sepals oblong or oblong-ovate, falcate, acute, 2.2

to 3 cm long, 1 to 1.5 cm wide. Petals slightly smaller than the sepals, elliptic-ovate, acute, somewhat constricted at the base, 2 to 3 cm long, 1 to 1.3 cm wide. Labellum fleshy, trilobed; middle lobe narrowly oblong or oblong-oblanceolate, entire, 1.3 to 1.5 cm long, 0.6 to 0.8 cm wide at the widest portion, white or purplish, with the tip greenish, with a crest of white hairs on the surface (these limited or extended), and a thin keel at the base; on the disk between the lateral lobes are a series of minute fleshy scales (few or many) with two forcepslike appendages in front, these white or phlox pink; lateral lobes erect, ligulate, typically double-toothed at the apex (we have a series from simple without tooth to deeply double-toothed), 6 to 7 mm long, 2.2 to 3 mm at the base, white with mallow pink or orange near the base. Column terete, clavate, white, the base light phlox purple, 12 to 13 mm long. Anther cap ovate, pale lumiere green. Pollinia two, ellipsoid.

LUZON, Nueva Vizcaya Province, Dupax, *Bur. Sci. 11136, 11141 McGregor:* Pangasinan Province, Mt. Isidro, *For. Bur. 8362 Curran & Merritt:* Bulacan Province, Norzagaray, *Bur. Sci. 13046 Ramos:* Manila, cultivated, *Bur. Sci. 84548, 84549 Quisumbing* (living plants from Mt. Mariveles, Bataan Province): Rizal Province, Pasay, cultivated, *Phil. Nat. Herb. 8079 Quisumbing* (living plants from Montalban, Rizal Province); without locality, *Loher 14650, Bur. Sci. 3069 Ramos:* Laguna Province, San Antonio, *Bur. Sci. 20443 Ramos, For. Bur. 19272 Curran, Loher 6005:* Tayabas Province, Mt. Binuang, *Bur. Sci. 28551 Ramos & Edaño;* Mt. Pular, *Bur. Sci. 19364 Ramos:* Sorsogon Province, Mt. Bulusan, *Elmer 15768.* POLILLO (Tayabas Province), *Bur. Sci. 10437 McGregor.* LEYTE, Tacloban, *For. Bur. 12452 Danao.*

A common and widely distributed species, epiphyte, at low altitude to 60 meters.

Phalaenopsis Lueddemanniana is a variable species, particularly in color. While in the typical forms the sepals and petals are transversed by bars of amethyst purple, in some other forms these bars are ferruginous and in others purplish with no bars; the background may be white or yellowish. As the differences between *P. Boxallii* and this species are merely in the color of the flowers, *P. Boxallii* is reduced to synonymy. There are five varieties which have been described; but as the differences are in color only, sizes and absence of bars on the petals and sepals, all are not recognized here. The species has

an interesting flowering habit; the flowers last two or three weeks on the plant, and opening one at a time. It starts flowering usually in November, and is in full display during December to January. It is not unusual to find the plant in flower during February up to July. The species is named in honor of M. Lüddemann, of Paris.

PHALAENOPSIS MARIAE Burb. Plate 1, fig. 7; Plate 4, figs. 10–18.

Phalaenopsis Mariae BURB. in Warner & Will. Orch. Alb. 2 (1883) *t. 80* et sub. *t. 87;* ROLFE in Gard. Chron. II 26 (1886) 277; HOOK. f. in Bot. Mag. 113 (1887) *t. 6964;* VEITCH, Man. Orch. Pl. pt. 7 (1891) 32; RIDL. in Jour. Linn. Soc. 31 (1896) 292; AMES in Phil. Jour. Sci. 8 (1913) Bot. 434, Orch. 5 (1915) 217, ex Merr. in Jour. Roy. Asiat. Soc. Straits Branch, Special No. (1921) 197, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 415.

Phalaenopsis Mariae Burb. var. *alba* AMES & QUIS. in Phil. Jour. Sci. 56 (1935) 461, *plate 2, figs. 3 & 4; plate 4, figs. 9 to 17; plate 7, fig. 2.*

The original description is as follows:

Phalaenopsis Mariae. Epiphytal. *Plant* stemless, with flat aërial clinging roots. *Leaves* deflexed, distichous, oblong or ligulate, acute, somewhat channelled, two inches or more in width, stoutish in texture, dark green, glossy, obscurely striate. *Scape* radical, bearing a many-flowered drooping raceme, shorter than the leaves, and proceeding from their axils. *Flowers* of medium size, elegantly coloured; *sepals* narrowly-oblong, bluntish, about an inch long, the lateral ones slightly falcate, white, with about six bold transverse bars or blotches of a deep chocolate red, the basal spots magenta-coloured like the lip; *petals* shorter, broader and more obovate, marked in a similar manner, but with fewer blotches, the colour being the same as in the sepals; *lip* obovate oblong, apiculate, convex, somewhat constricted at the sides, of a rich deep magenta-rose, the middle lobe plane not pilose. *Column* short, white, without fringes at the apex.

—BURB. in Warner & Will. Orch. Alb. 2 (1883) *t. 80* et sub. *t. 87.*

Phalaenopsis (*Stauroglottis*) *Mariae;* caule brevissimo, foliis oblongis v. late lineari-oblongis apicibus acutis saepe recurvis basi uno latere auriculatis, panicula gracili longe pedunculata pluriflora, floribus 1½ poll. latis, sepalis petalisque subaequalibus lineari-oblongis obtusis albis violaceo-fasciatis, labelli lobis lateralibus angustis corniformibus subrecurvis magnibus inflexis, intermedio oblongo purpureo albo marginato basi 2-calcarato, disco villis erectis onuto, columna medio constricta, apice nuda.

—HOOK. F. in Bot. Mag. 113 (1887) *t. 6964.*

Resembles *P. Lueddemanniana* in habit. Leaves linear oblong-oblanceolate, acute, 19 to 40 cm long, 4 to 7 cm wide, dark green, shining above. Scape sparingly branched, few-flowered, 13 to 50 cm long; peduncles and rachis slender, 2 to 2.5 mm

in diameter. Flowers odorless, sometimes slightly fragrant, 2.8 to 3 cm across. Pedicellate ovary slender, white, 1.2 to 1.5 cm long. Lateral sepals obliquely elliptic-ovate, obtuse, apiculate, 1.5 to 1.7 cm long, 0.8 to 0.9 cm wide. Dorsal sepal narrowly oblong, obtuse, 1.4 to 1.7 cm long, 0.7 to 0.9 cm wide. Petals elliptic, obtuse, 1.3 to 1.6 cm long, 6.5 to 8 mm wide. Labellum fleshy, 3-lobed; lateral lobes obliquely oblong, erect, incurved towards the column, 5 to 6 mm long, white, purple and retuse at the apex and base; middle lobe obovate, broad at the apex, 8 to 12 mm long, 6.5 to 8 mm wide at the widest portion, prominently keeled in the middle longitudinally, the keel clothed with hairs on the anterior part, phlox purple except the margins and hairs. Column white, 7 to 8 mm long. Anther cap broadly ovate. Pollinia ellipsoid.

MINDANAO, Lanao Province, Camp Keithley, *Clemens 626*, *Clemens, s. n.:* Davao Province, Davao, *Loher 6011:* Bukidnon Province, without locality, *Bur. Sci. 21433 Escritor, Bur. Sci. 84781 Quisumbing* (cultivated in Manila); Mt. Dalirig, *Bur. Sci. 21389 Escritor:* without province or locality, *Bur. Sci. 5655 Mrs. Lyons* (cultivated in Manila). In addition to above I have flowers in liquid from plants collected in Cotabato Province and from Jolo. The two collections from Dupax, Nueva Vizcaya Province, Luzon, made by McGregor, previously identified as *P. Mariae*, belong to a form of *P. Lueddemanniana.*

This species is closely allied to *P. Lueddemanniana* Reichb. f. from which it differs in the size of the flowers and in the obtuse sepals and petals. While the typical labellum of *P. Lueddemanniana* has oblong middle lobe, in this species it is obovate, with the apex much broader. The sepals are chartreuse yellow with 4 or 5 chestnut transverse bars. The plant blooms during June to September, usually in July and August. A white variety was reported by Ames and Quisumbing, and this differs from the species in its flowers (pure white except the yellow tips of the sepals and petals). It is known locally as "Flor de la mañana" because of its habit in blooming early in the morning. The species is dedicated to Mrs. Burbidge.

PHALAENOPSIS MICHOLITZII Rolfe. Plate 1, fig. 8; Plate 4, figs. 19–26.

Phalaenopsis Micholitzii ROLFE in Gard. Chron. III 8 (1890) 197, in Journ. des Orch. 1 (1890) 198, in Orch. Rev. 13 (1905) 229; AMES, Orch. 5 (1915) 217, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 415; AMES & QUIS. in Phil. Jour. Sci. 52 (1933) 454–456, *plate 2, figs. 1 and 2; plate 5, figs. 25 to 33; plate 12, fig. 2.*

The original description is as follows:

From Messrs. F. Sander & Co., St. Albans, came a group of orchids, embracing some fine forms of Cattleya Gaskelliana, C. Dowiana, C. Nilssoni, and C. Schofieldiana; also Masdevallia Amesiana (Veitchi x Tovarense), apricot colour; angraecum articulatum, pure white, the flowers about 1 inch across; and *Phalaenopsis Micholitzii*, the flower of which is greenish white, the long and rather narrow lip white, with coarse hairs and a yellow crest; the leaves are ovate, and shiny-green, about 7 inches in length.—ROLFE, loc. cit. 187.

Herba *P. Lueddemannianæ* habitu. Caulis abbreviatus, paucifoliatus. Folia oblongo-oblanceolata, ad basim sensim angustata, carnosa. Scapi breves, simplices, pauciflori. Flores subflavidi et sine maculis. Sepala lateralia oblique ovata, acuta. Sepalum dorsale oblongo-ellipticum, obtusum. Petala ovato-elliptica, breviter unguiculata. Labellum trilobatum; lobi laterales erecti, subquadrato-oblongi, apice bidentato truncato; lobus intermedius rhombico-spathulatus, inferne unguiculatus, apice obtuse tridentatus; discus supra medium papillis capilliformibus numerosis ornatus. Columna flavida.

Habit similar to that of *P. Lueddemanniana* Reichb. f. Stem abbreviated. Leaves oblong-oblanceolate, 13 to 17.5 cm long, 5.5 to 7 cm wide, broadly obtuse at the apex, gradually tapering to the base, pale green, fleshy, thick, very slightly rigid, somewhat conspicuously nerved with yellowish nerves. Scapes simple, short, few-flowered, 3 to 6 cm long, appearing in the axils of the leaves or at the base of the stem near the roots; rachis very short. Flowers odorless, 6 to 6.5 cm across, yellowish, and absolutely without transverse bars on the sepals and petals, 1 or 2 opening at a time. Pedicellate ovary marguerite yellow, about 3.3 cm long, the ovary terete, not twisted. Lateral sepals obliquely ovate, acute, apiculate, 3.2 to 3.3 cm long, 1.6 to 1.7 cm wide, 9-nerved. Dorsal sepal oblong-elliptic, obtuse, 3.2 to 3.3 cm long, 1.5 to 1.6 cm wide, 9-nerved. Petals ovate-elliptic, obtuse, about 2.8 cm long, 1.7 cm wide, with shortly stalked base which is about 4 mm long, 7-nerved. Labellum fleshy, 3-lobed; lateral lobes erect, subquadrate-oblong, with a prominent fleshy callus above the middle, bidentate at the truncate apex, about 8 mm long, cadmium yellow; middle lobe rhombic-spathulate, about 1.9 cm long, narrowed below into a distinct claw about 7 mm long, obtusely tridentate at the apex when spread out, the irregular margins minutely crisped-undulate, marguerite yellow; disc (between the side lobes) with a ligulate sharply bidentate callus which extends (in the middle of the claw) into a median high keel dentate in front, and which is succeeded by an irregular longitudinal cluster of hair-

like papillæ. Column about 1.2 cm long, marguerite yellow; anther white.

LUZON, Manila, Bureau of Science orchid house, *Bur. Sci. 85572 Eduardo Quisumbing*, February 3, 1932.

A living plant of this species was sent to the author by Mr. F. E. Shafer, an orchid enthusiast of Cebu, who purchased it from a peddler in Cebu. Its origin is unknown, but is doubtless Philippines.

A species with the habit of *P. Lueddemanniana* Reichb. f., differing conspicuously in its yellowish flowers with absolutely no bars on the sepals and petals, and in the rhombic-spatulate middle lobe of the labellum.

EXCLUDED SPECIES

Phalaenopsis cornu-cervi Blume apud NAVES, Novis. App. (1882) 243.
Phalaenopsis deliciosa Reichb. f. apud NAVES, Novis. App. (1882) 243.
Phalaenopsis Devriesiana Reichb. f. apud NAVES, Novis. App. (1882) 243.
Phalaenopsis hebe Reichb. f. apud NAVES, Novis. App. (1882) 242.
Phalaenopsis Lowii Reichb. f. apud NAVES, Novis. App. (1882) 243.
Phalaenopsis Parishii Reichb. f. apud NAVES, Novis. App. (1882) 243.
Phalaenopsis sumatrana Korth apud NAVES, Novis. App. (1882) 242.
Phalaenopsis violacea Teijsm. & Binn. apud NAVES, Novis. App. (1882) 243.

DOUBTFUL SPECIES

PHALAENOPSIS FASCIATA Reichb. f.

Phalaenopsis fasciata REICHB. f. in Gard. Chron. n. s. 18 (1882) 134; ROLFE in Orch. Rev. 13 (1905) 225; AMES, Orch. 5 (1915) 217, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 414.

The original description is as follows:

This is like *Phalaenopsis sumatrana* in the shape of the light yellow sepals and petals, which have numerous cinnamon bars. The lip has sulphur-colour lateral divisions, which are retuse, and have a blunt keel with a knob parallel to the anterior margin. Between both on the disc is a number of retrorse toothletted orange plates, and two conical papulæ terminating in bristles stand before the base of the median partition. The latter is oblong ligulate (blunt), with a deep, abrupt, membranous keel. The anterior part of it is light purple, the superior orange. There is no cushion of hairs, as in *P. sumatrana* and *Lüddemanniana;* hence, according to artificial characters, it might be regarded as nearest to *Phalaenopsis violacea*, yet the shape of the sepals and petals is markedly different. The sepals have no median keels outside. The top of the lip is totally distinct also. Leaves and roots are said to be quite like those of *Phalaenopsis Lüddemanniana.*

As it is, we cannot now but regard it as distinct, though quite prepared to have one day a rebuke by the occurrence of some intermediate type.

—H. G. RCHB. F.

Phalaenopsis fasciata, n. sp.—Sepals tepalisque oblongis obtusis; labelli partitionibus lateralibus divaricatis retusis cum apiculo latere antico callosis, partitione mediana oblongo-ligulata apice obtusiuscule acuta, lamellis in cristulas solutis in basi; lamelli compresso-conicis aristatis in basi, partitionis anticae carina a basi partitionis madianae in discum, ibi abruptas; columna basi utrinque dilatata. Barba in labelli apice nulla. Folia et radices Phalaenopsidis Lüddemannianae. Sepala ac tepala sulphurea striis cinnamomeis. Labelli partitiones laterales sulphyreae punctulis pallidis cinnamomeis paucis. Partitio mediana postice aurantiaca, antice pallide violaceo-purpurea. Columna basi utrinque purpurea.—Ex Philipp. insul. Imp. cl. Low. H. G. Rchb. f.—REICHB. f. loc. cit. 134.

No material of this species has been seen. Reichenbach f. gave the origin of this plant as Philippines, imported by Messrs. Hugh Low and Co. Reichenbach f. further states that the species is near *P. Lueddemanniana*. Judging by the color of the flower and the description of the flower parts, the species belongs to the *Boxallii* group, *P. Lueddemanniana* differing in the absence of hairs on the crest of the keel of the middle of the lip. The absence of these hairs cannot be used as distinctive and specific character, as this feature is very variable in *P. Lueddemanniana*. A critical examination of the type, if existing, may prove it to be a mere variant of *P. Lueddemanniana*, which is a very variable species.

PHALAENOPSIS FUSCATA Reichb. f.

Phalaenopsis fuscata REICHB. f. in Gard. Chron. II 2 (1874) 6; ROLFE in Orch. Rev. 13 (1905) 226; AMES, Orch. 5 (1915) 216, ex. Merr. Enum. Phil. Fl. Pl. 1 (1925) 414.

Phalaenopsis denisiana COGN. in Gard. Chron. III 26 (1899) 82; COGN. in Dict. Icon. Orch. (1899) Phalaenop. *t. 6*.

The original description is as follows:

Once more a few Phaloenopsis—now-adays a very unusual source of gratification. It appears to have very large leaves, and I suppose that the inflorescence may be like that of *P. cornu-cervi*, since the plant was well compared with it. The flowers are yellowish, mottled with brown, and very fleshy. The lip is quite peculiar, and the lateral sepals are not so much extended as in *P. cornu-cervi.* I have to thank for it Mr. Bull, who introduced it from the Malay Peninsula.—H. G. RCHB. f.

Aff. *P. cornu-cervi*, radicibus brevibus; foliis amphissimis oblongis obtuse acutis (pedunculo certe *P. cornu-cervi?*); floribus mediocribus illos speciei dictae acquantibus; sepalis oblongis obtuse acutis; tepalis cuneato-oblongis obtusis; labello tripartito, partitionibus lateralibus ligulatis retusis utrinque

unidentatis, latere inferiore medio umbonatis, partitione media oblonga acuta, per medium carinata; callo bidentato in basi, postposita ligual aristata utrinque, columna basi exangulata.—REICHB. F. loc. cit. 6.

The origin of *P. fuscata* was reported as the Malay Peninsula; that of *P. denisiana* as Philippines. I have on hand material of so called *P. fuscata*, an imported plant from Singapore. If my material is indeed a *fuscata*, it is distinct, and is closely allied to *P. Lueddemanniana.* No material of *P. denisiana* has been seen.

PHALAENOPSIS PALLENS (Lindl.) Reichb. f.

Phalaenopsis pallens (Lindl.) REICHB. f. in Walp. Ann. 6 (1864) 932; ROLFE in Gard. Chron. II 26 (1886) 276, in Orch. Rev. 8 (1900) 327, 13 (1905) 226.

Trichoglottis pallens LINDL. in Jour. Hort. Soc. 5 (1850) 34, in Paxt. Flow. Gard. 1 (1850) 15.

Stauropsis pallens REICHB. f. in Hamb. Gartenz. 16 (1860) 117, Xen. Orch. 2 (1862) 7; NAVES, Novis. App. (1882) 243.

For many years this species was ascribed to the Philippines. It does not occur in the Archipelago, and Rolfe, loc. cit., has shown that the type could not have come from the Philippines.

PHALAENOPSIS REICHENBACHIANA Reichb. f. and Sander.

Phalaenopsis Reichenbachiana REICHB. f. & SANDER in Gard. Chron. II 18 (1882) 586; ROLFE in Orch. Rev. 13 (1905) 226; AMES, Orch. 5 (1915) 218, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 416.

No material of this species has been seen. According to Rolfe (Orch. Rev. loc. cit.) Micholitz stated that this species is a native of Mindanao. By its description it is perhaps a *P. Lueddemanniana.*

PHALAENOPSIS VEITCHIANA Reichb. f.

Phalaenopsis Veitchiana REICHB. f. in Gard. Chron. (1872) 935; BURB. in Floral Mag. 15 (1876) *t. 213;* VEITCH, Man. Orch. Pl. pt. 7 (1898) 47; AMES, Orch. 5 (1915) 218, ex Merr. Enum. Phil. Fl. Pl. 1 (1925) 417; G. WILSON in Orch. Rev. 30 (1922) 346.

Rolfe[11] suggested that this species is a hybrid between *P. Schilleriana* and *P. equestris,* and mentioned the fact the middle lobe of the lip has anchorlike appendages. An examination of the type, which I have not seen, will throw light of its status and its relation to *P. Gertrudae,* which is a natural hybrid between *P. equestris* and *P. Schilleriana.*

[11] See Ames in Phil. Jour. Sci. 4 (1909) Bot. 599.

ILLUSTRATIONS

[The colored drawings were made by Mr. Pedro L. Ramos and the line drawings by Mr. Ricardo C. Aguilar, both scientific illustrators of the Natural History Museum]

PLATE 1

FIG. 1. *Phalaenopsis equestris* (Schauer) Reichb. f. Front view of flower, × 1.

2. *Phalaenopsis Lindenii* Loher. Front veiw of flower, × 1.
3. *Phalaenopsis Lueddemanniana* Reichb. f. Front view of typical flower, × 1.
4. *Phalaenopsis Lueddemanniana* Reichb. f. Side view of flower, the form with greenish background, × 1.
5. *Phalaenopsis Lueddemanniana* Reichb. f. Front view of flower, the *Boxallii* form with yellow background and ferruginous bars, × 1.
6. *Phalaenopsis Lueddmanniana* Reichb. f. Side view of lip, × 2.
7. *Phalaenopsis Mariae* Burb. Front view of flower, × 1.
8. *Phalaenopsis Micholitzii* Rolfe. Front view of flower, × 1.

PLATE 2

Phalaenopsis equestris (Schauer) Reichb. f.: *1*, habit of the plant, one-third natural size; *2*, from view of flower, × 1; *3*, side view of flower, × 1; *4*, dorsal sepal, × 2; *5*, petal, × 2; *6*, lateral sepal, × 2; *7*, side view of column, × 2; *8*, front view of column, × 2; *9*, labellum from above (stretched out), × 2; *10*, anther cap, from above, × 5; *11*, anther cap from below, × 5; *12*, pollinia, × 5.

PLATE 3

Phalaenopsis Lueddemanniana Reichb. f.: *1*, habit of plant, × 0.5; *2*, dorsal sepal, × 1; *3*, lateral sepal, × 1; *4*, petal, × 1; *5*, one form of labellum (expanded), × 2; *6*, another form of labellum (expanded), × 2; *7*, still another form of labellum (expanded), × 2; *8*, side view of column and labellum, × 2; *9*, front view of column and labellum, × 2; *10*, anther cap from below, × 5; *11*, anther cap from above, × 5; *12*, pollinia, × 5.

PLATE 4

Phalaenopsis Lindenii Loher: *1*, dorsal sepal, × 2; *2*, lateral sepal, × 2; *3*, petal, × 2; *4*, labellum (expanded), × 2; *5*, front view of column, × 2; *6*, side view of column, × 2; *7*, anther cap from above, × 5; *8*, anther cap from below, × 5; *9*, pollinia, × 10.

Phalaenopsis Mariae Burb.: *10*, dorsal sepal, × 2; *11*, lateral sepal, × 2; *12*, petal, × 2; *13*, front view of column and labellum, × 2; *14*, labellum (expanded), × 2; *15*, side view of column and labellum, × 2; *16*, anther cap from above, × 5; *17*, anther cap from below, × 5; *18*, pollinia, × 10.

Phalaenopsis Micholitzii Rolfe; *19*, dorsal sepal, × 1; *20*, lateral sepal, × 1; *21*, petal, × 1; *22*, labellum (expanded), × 2; *23*, side view of column and labellum, × 2; *24*, front view of column and labellum, × 2; *25*, anther cap from above, × 5; *26*, pollinia, × 5.

PLATE 5. PHALAENOPSIS LINDENII LOHER

FIG. 1. Habit with leaves and flowers, much reduced.
2. Portion of leaf showing maculations and tip of inflorescence with buds and opened flower, slightly enlarged.

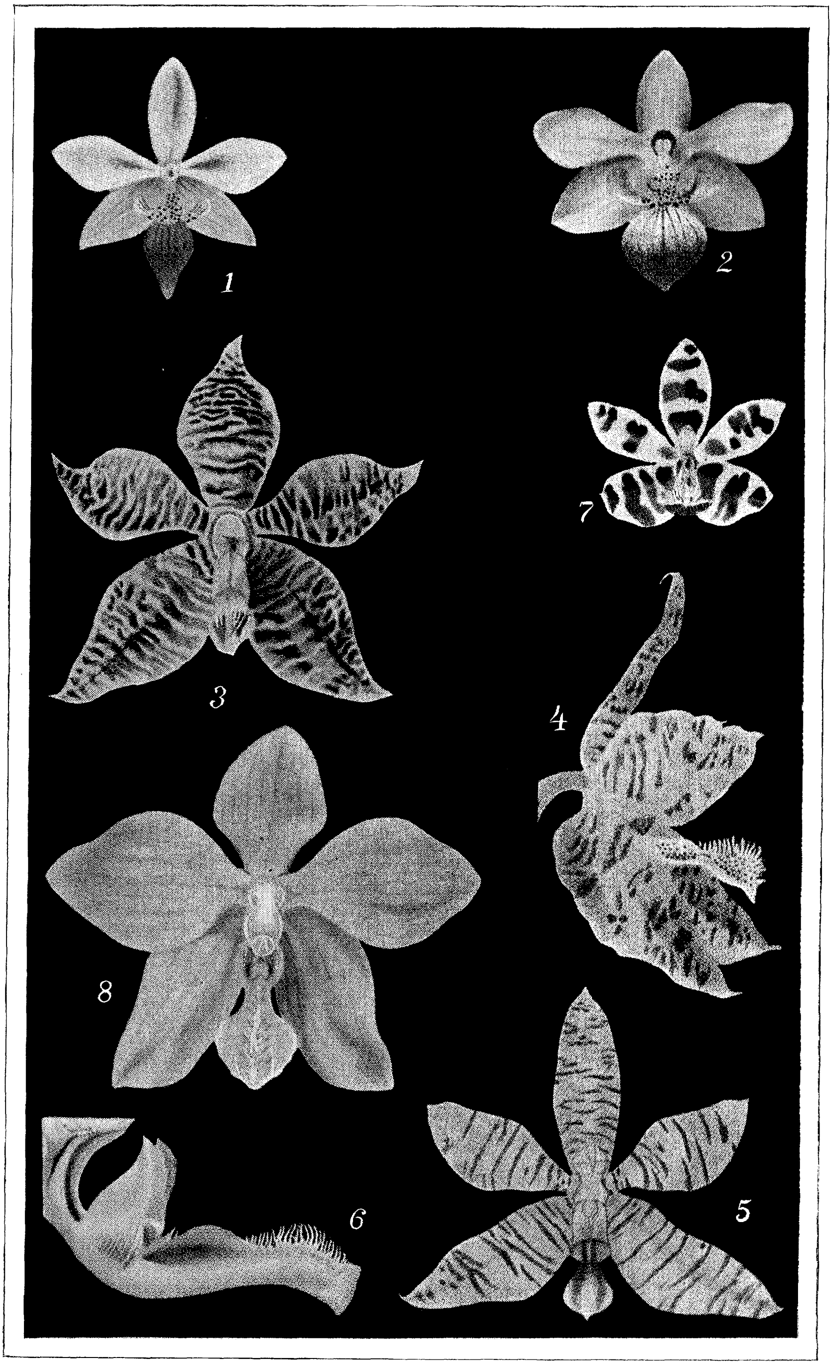

PLATE 1.

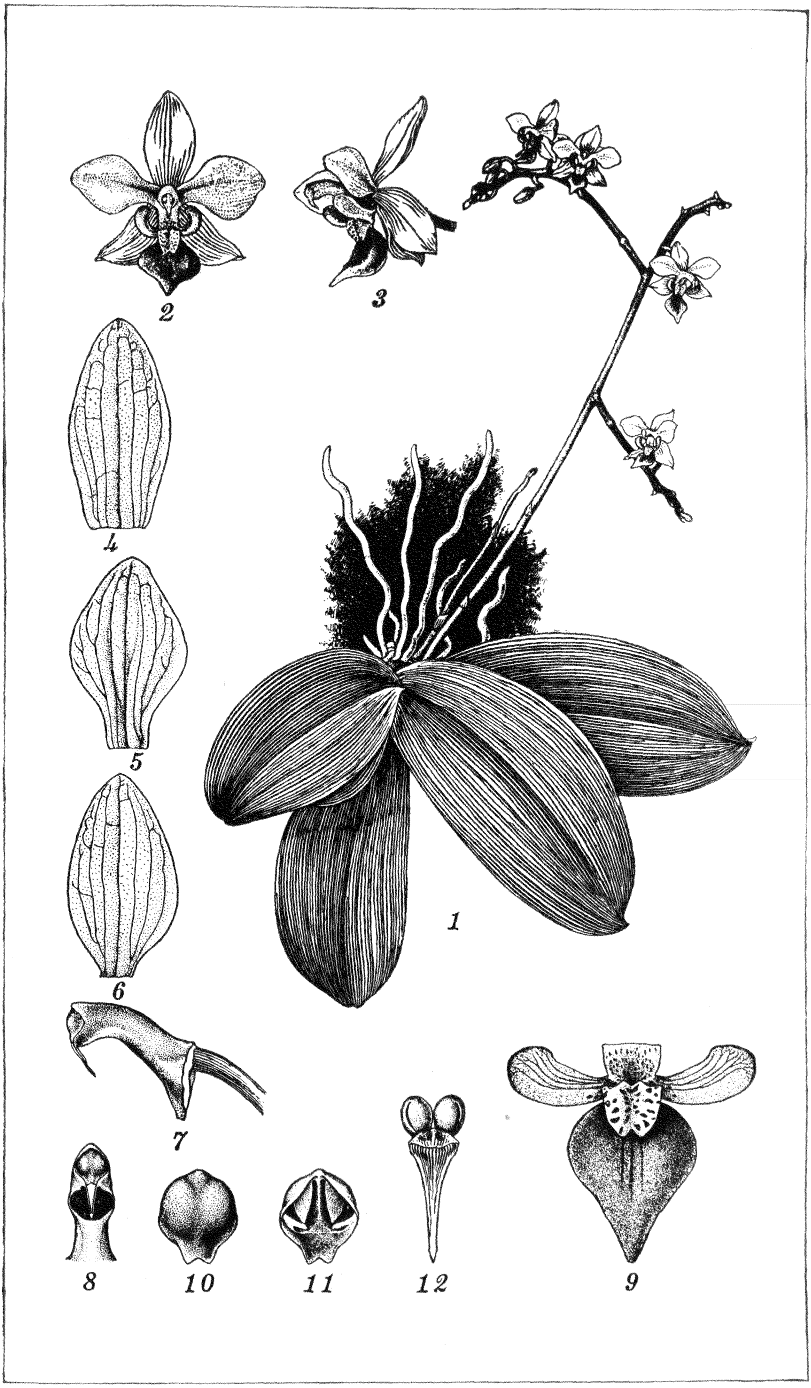

PLATE 2.

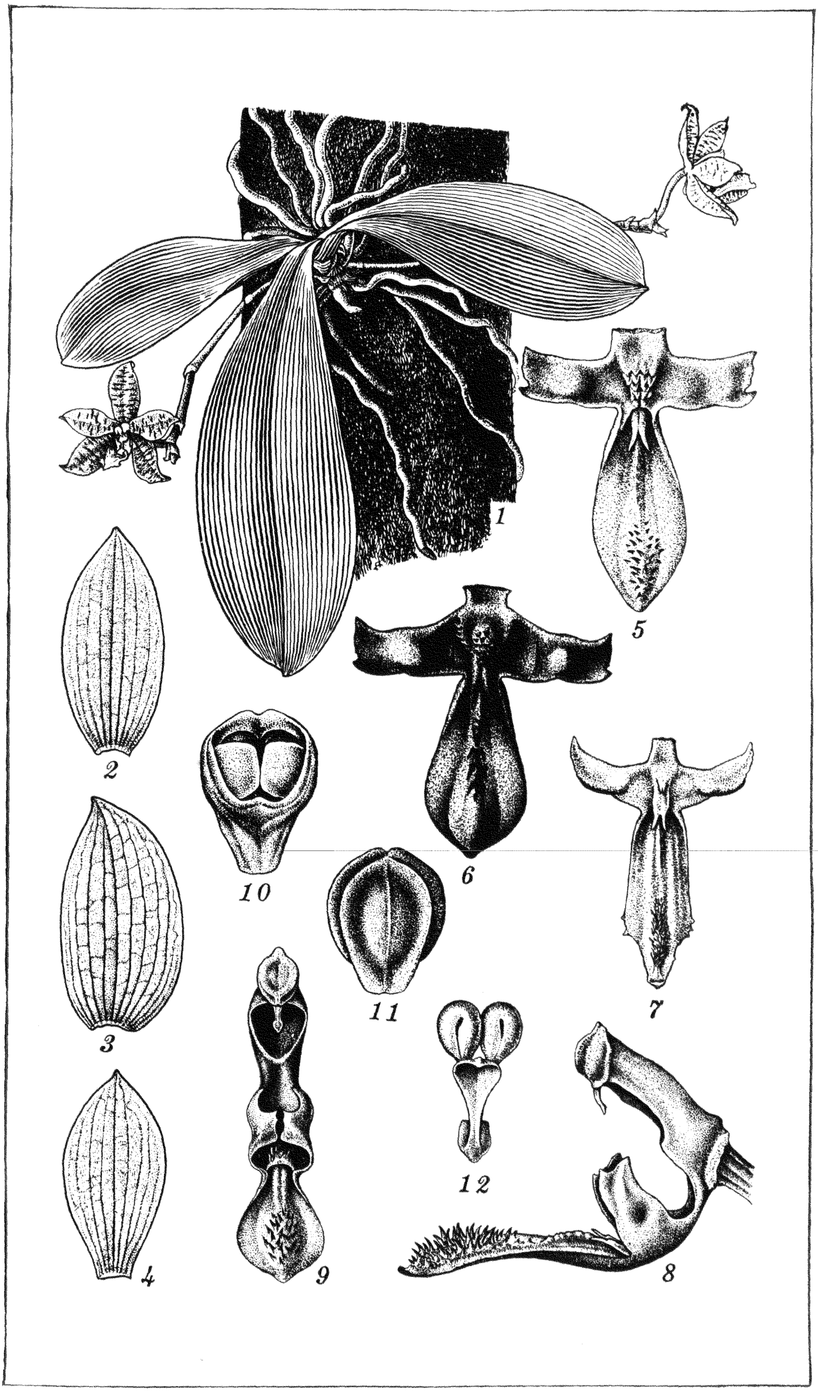

PLATE 3.

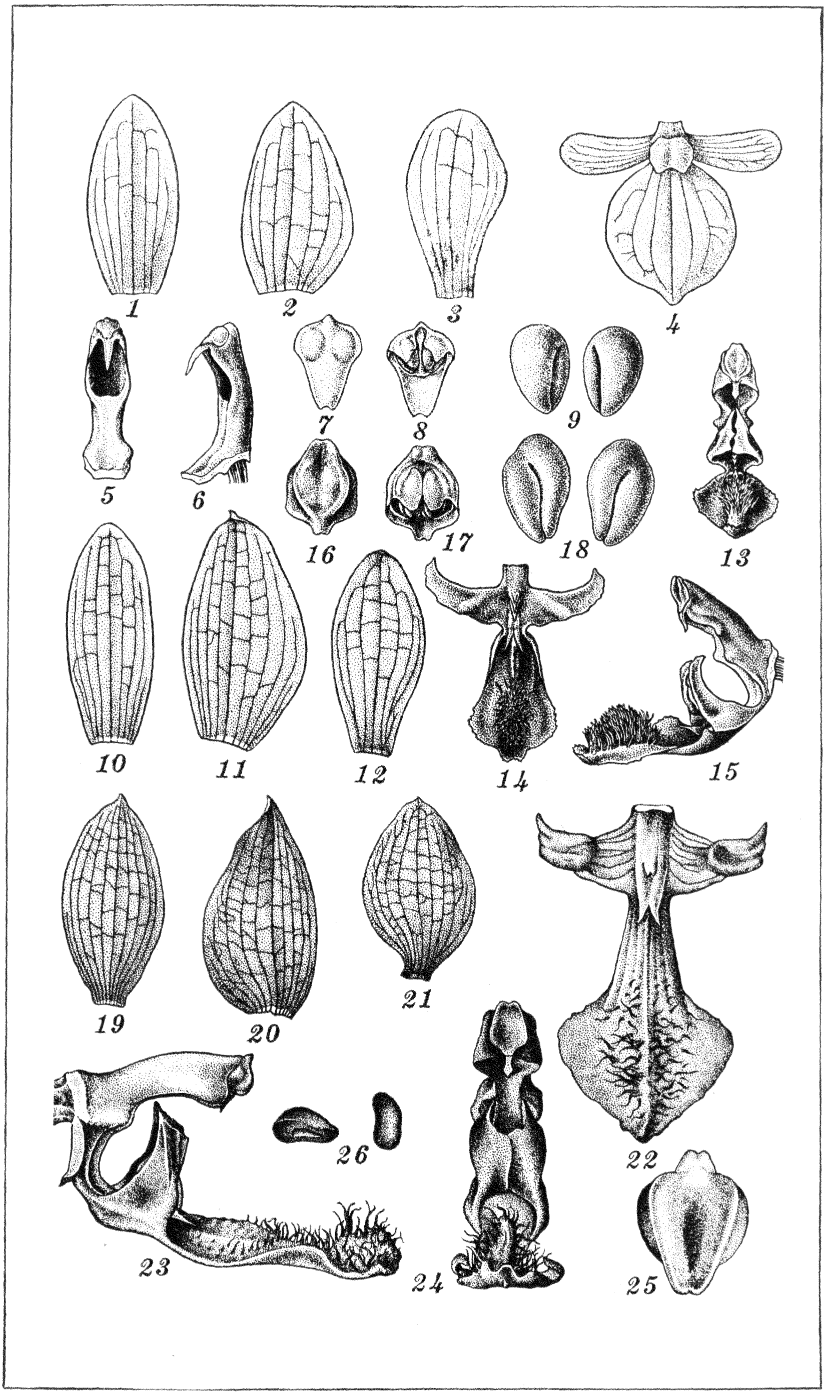

PLATE 4.

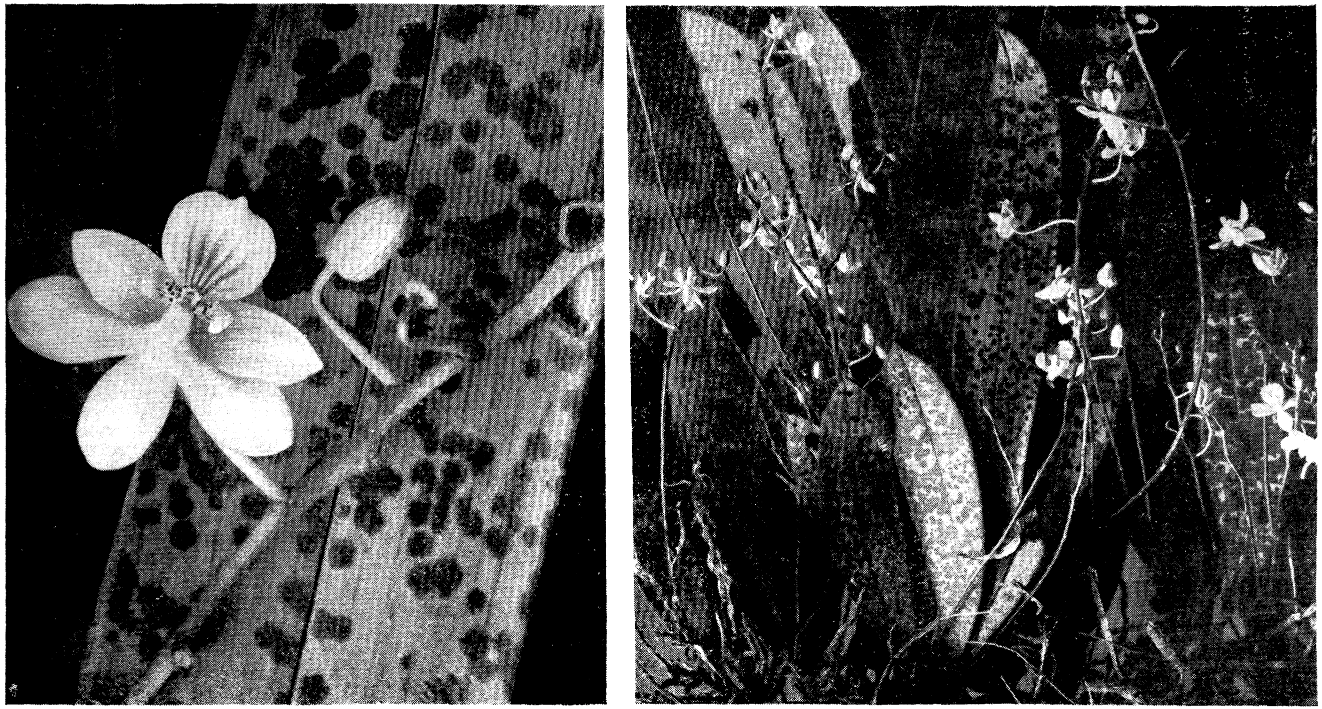

PLATE 5.

NOTES ON THE ANTHELMINTIC PROPERTIES OF THE LATEX OF PAPAYA (CARICA PAPAYA LINN.) AND OF "ISIS" (FICUS ULMIFOLIA LAM.)

By MARCOS A. TUBANGUI and MARIANO BASACA
Of the Bureau of Science, Manila

According to Tavera (1892), Guerrero (1921), and other botanical writers, there are many species of plants in the Philippines which are of medical importance. Some of these plants are of known therapeutic value and appear in contemporary pharmacopoeias, according to Valenzuela, Concha, and Santos (1946). There are others, however, the efficacy of which has not yet been accurately determined.

The purpose of this paper is to record the results of a study on the anthelmintic properties of a few common plants. The latex of the following nine species representing three families was examined: (1) Moraceæ—*Ficus balete* Merr., *F. nota* (Blanco), *F. odorata* (Blanco), *F. pisifera* Wall., *F. ulmifolia* Lam., *Castilloa elastica* Cerv., and *Artocarpus integra* Thunb.; (2) Sapotaceæ—*Achras zapota* Linn.; and (3) Caricaceæ—*Carica papaya* Linn. Several members of the genus *Ficus* were included in the study because of their systematic relationship with *Ficus doliaria,* a South American wild fig, the latex of which has been proven to be an efficient anthelmintic against ascarids and trichurids. In the case of papaya, according to Tavera (1892) and Berger and Asenjo (1940), the crude latex has long been known to have anthelmintic properties, but the available literature does not show that its efficacy has been critically tested.

METHODS

Collection and preservation of latex.—Latex samples were obtained by wounding the trunk, stems, and unripe fruits of a plant with a clean knife and placing the partly coagulated milky juice that exudes in a bottle containing sodium benzoate dissolved in normal salt solution. The proportion of latex to salt solution was 4 to 1 and the final concentration of the sodium benzoate 1 per cent. The samples were kept at room temperature and used within one week after collection. Some

samples were mixed with two to three volumes of alcohol and the precipitated proteinates were filtered off, dried over calcium chloride, and ground into coarse powders.

In vitro tests.—The samples were screened by means of the worm-digesting method of Robbins (1930). One or two live *Ascaris lumbricoides* collected from swine were immersed in a 5 per cent emulsion of latex, or 1 per cent emulsion of proteinate derivative, in Ringer's solution. Another set of worms immersed in Ringer's solution alone served as control. The parasites were then placed in an incubator at 37° C. and examined at one-hour intervals for any evidence of anthelmintic effect.

In vivo tests.—The samples that showed marked anthelmintic activity *in vitro* were selected for further study. These samples were tested for toxicity by feeding them in large doses to guinea pigs and rats. If found nontoxic, they were given in varying amounts to young dogs and human volunteers infected with different kinds of intestinal worms. They were mixed with two volumes of water and a little amount of sugar and given early in the morning on an empty stomach followed after one or two hours with sodium sulphate. The human cases were worm-egg-counted before and two to three weeks after treatment. The dogs were worm-egg-counted before treatment and on the third day after treatment they were sacrificed and examined for parasites. The fæces of all the cases passed during the first twenty-four hours after treatment were collected and sieved for the presence of worms.

RESULTS

In Table 1 are summarized the results of the *in vitro* tests. Of the nine species of plants tested only *Carica papaya* and *Ficus ulmifolia* were found to possess marked anthelmintic properties. The others were either inert or only slightly active. The *Ascaris* worms placed in the latex of *Carica papaya* and of *Ficus ulmifolia* were either dead or moribund one hour after immersion, and their cuticles showed the presence of small blisters in several places. Some of these blisters eventually ruptured, allowing the reproductive organs of the parasites to protrude through the openings. The worms appeared much distorted, later undergoing more or less complete disintegration. Worms placed in 1 per cent emulsions of the proteinate deri-

vatives prepared from the saps of the two plants were similarly affected.

TABLE 1.—*In vitro effect of the latex of plants on Ascaris lumbricoides.*

Kind of plant	Effect after—			
	1 hour	2 hours	4 hours	8 hours
Ficus balete	Alive	Alive	Alive	Alive.
Ficus nota	do	do	do	Do.
Ficus odorata	do	do	Moribund	Dead, with few blisters.
Ficus pisifera	do	do	Alive	Alive.
Ficus ulmifolia	Dead, with few blisters	Ulcerated	Ulcerated	Body much distorted.
Artocarpus integra	Alive	Alive	Alive	Alive.
Castilloa elastica	do	do	do	Do.
Achras zapota	do	do	do	Do.
Carica papaya	Moribund	Dead, with blisters	Ulcerated	Body much distorted.
Control: Ringer's solution.	Alive	Alive	Alive	Alive.

The results of the treatment are shown in Tables 2 and 3. Four pups infected with ascarids (*Toxocara canis*) and hookworms (*Ancylostoma caninum*) were given 5 mils each of papaya latex. Twenty-eight dead ascarids were collected from the fæces of these animals on the first day of treatment, but no hookworms were found. At autopsy large numbers of hookworms were recovered from the intestines of each, but all of them were free of ascarids. The efficiency of papaya latex in this series of animals is thus 100 per cent against ascaris and apparently 0 per cent against hookworms.[1]

Four persons infected with *Ascaris* and *Trichuris* were given papaya latex in doses of 30 to 50 mils depending upon age and size. All of them passed dead worms during the first day of treatment, but when examined two weeks later one was still positive for *Ascaris* and three still harbored *Trichuris* (Table 3). There was, however, a 44.4 per cent reduction in the *Ascaris* egg count of the person still positive for *Ascaris* and an average of 58.5 per cent reduction in the *Trichuris* egg

[1] In later experiments it was determined that the latex of *Carica papaya* and of *Ficus ulmifolia* has no effect *in vitro* on live dog hookworms.

counts of the three still positive for *Trichuris*. The efficiency of papaya latex in this series is thus 79.6 per cent against *Ascaris* and 71 per cent against *Trichuris*.

TABLE 2.—*Effect of papaya latex on Toxocara canis in dogs.*

Dog Number	Weight	Dose	Worms recovered from faeces	Worms found at autopsy	Reduction
	kg.	*ml.*			*Per cent*
1	1.2	5.0	6	0	100
2	1.5	5.0	12	0	100
3	1.4	5.0	3	0	100
4	1.5	5.0	7	0	100
Total	-----	-----	28	0	100

TABLE 3.—*Effect of the latex of Carica papaya and of Ficus ulmifolia on intestinal worms in man.*

Name	Age	Sex	Dose	Egg counts per ml. of faeces: Before treatment			After treatment			Worms recovered from faeces
				Ascaris	*Trichuris*	Hookworms	*Ascaris*	*Trichuris*	Hookworms	
	Years		*ml.*							
				Carica papaya series						
L. N.	15	F	40	6,500	600	-----	-----	-----	-----	4 *Ascaris*.
R. R.	10	M	30	20,500	2,900	-----	11,400	1,900	-----	2 *Ascaris*, 2 *Trichuris*, 4 pinworms.
E. R.	12	F	30	12,000	3,100	-----	-----	400	-----	3 *Ascaris*, 5 *Trichuris*, 4 pinworms.
B. H.	54	M	50	17,000	1,000	-----	-----	600	-----	-----
				Ficus ulmifolia series						
A. N.	13	F	15	70,000	2,500	1,200	-----	150	1,400	21 *Ascaris*, 4 *Trichuris*.
D. M.	24	M	25	12,500	3,600	-----	-----	-----	-----	8 *Ascaris*, 6 *Trichuris*.
S. A.	46	M	30	-----	5,600	-----	-----	600	-----	14 *Trichuris*, 12 pinworms.

Three persons were given *Ficus ulmifolia* latex in doses of 15 to 30 mils each. They all passed dead worms during the first day of treatment. The two cases infected with *Ascaris* were found to be free of the parasite when examined three weeks later. Of the three individuals infected with *Trichuris* only one was completely cured, but there was an average reduction of 91 per cent in the *Trichuris* egg counts of the other two. There was no significant change in the hookworm egg counts of the individual infected with hookworms before and after the treatment. The efficiency of the latex of *Ficus ulmi-*

folia in this small series is thus 100 per cent against *Ascaris*, 93.6 per cent against *Trichuris*, and 0 per cent against hookworms.

Two persons in the papaya group and one in the *Ficus* group passed some pinworms (*Enterobius vermicularis*) along with other dead parasites, indicating that the saps of *Carica papaya* and *Ficus ulmifolia* also have enterobicidal properties.

The ascarids recovered from the fæces of the dogs and the human cases showed blisters and ulcers on their cuticles, and some were broken into fragments and in advanced stages of degeneration. A few *Trichuris* were also blistered, but their bodies were intact. The pinworms did not appear damaged externally.

DISCUSSION

The results of the various tests show that the anthelmintic properties of the saps of *Carica papaya* and *Ficus ulmifolia* are similar to those of higuerolatex, as reported by Caldwell and Caldwell (1929), Brooks and Brown (1942), and others. The latex of *Ficus ulmifolia* appears to be more efficient than papaya latex, but unfortunately it is difficult to obtain in large quantities. Both products were well tolerated by the cases treated, but one contraindication against their use is the presence of open lesions in the digestive tract. This is due to the fact that the effective anthelmintic principles are proteolytic enzymes (ficin and papain) which are capable of digesting not only live worms but also injured mucous membranes.

SUMMARY

The latex of *Carica papaya* and of *Ficus ulmifolia* out of nine species of plants tested was found to possess anthelmintic properties against ascarids, trichurids, and pinworms. Papaya latex was 100 per cent effective against the dog ascarid, 79.6 per cent against human *Ascaris* and 71 per cent against *Trichuris*. The latex of *Ficus ulmifolia* was 100 per cent against *Ascaris* and 93.6 per cent against *Trichuris*. Both products were inactive against hookworms.

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THE TREATMENT OF FASCIOLIASIS IN DAIRY CATTLE AND IN INDIAN BUFFALOES WITH HEXACHLORETHANE AND KAMALA EXTRACT

By PEDRO G. REFUERZO [1]

Of the Division of Parasitology and Protozoölogy
Bureau of Animal Industry, Manila

Fascioliasis, or liver rot, is one of the most destructive of the parasitic diseases of ruminants in the Philippines. It is caused by either one or both of *Fasciola hepatica* Linn. and *F. gigantica* Cobbold which infect upwards from 1.66 to 19 per cent of cattle and/or carabaos, *Bubalus bubalis* Ledg. (Robles, 1932; De Jesus, 1938; Arañez, unpublished). Alone, this scourge has been responsible for the condemnation of no small number of liver portions or even of the whole organ, apart from the considerable loss caused by retarded growth, lowered milk production, curtailed breeding activity, emaciation, and death of infected animals. Thus, it is an economic problem of great concern both to the stockman and to the veterinarian.

Owing to the above considerations, and in keeping with the general program of this institution of finding cheap expedients (and where known, to determine their relative efficacy) for the treatment of the more important parasites of livestock, hexachlorethane-kamala extract mixture was tried against this infection in dairy cattle and in Indian buffaloes, *Bubalus buffelus.*

REVIEW OF THE LITERATURE

Although the discovery by Jehan de Brie of *Fasciola hepatica* as the causative agent of sheep liver rot was made as early as 1379, it was in the nineteenth century that the treatment for this disease really gained impetus and has since engaged the attention of various workers throughout the world. Grassi and Calandruccio (1884) appear to have pioneered in the medication of this scourge in sheep using extract of male fern. Giving orally a single dose of 5 grams of ethereal extract of male fern in 50 grams of the ethereal tincture, these workers observed the expulsion of numerous flukes in the feces after 24 to 48 hours and the disappearance after the third day of the eggs in the dung and of the adult worms at autopsy. Two years later (1886) Perroncito tried the same experiment.

[1] Member of the Faculty of the College of Veterinary Science, University of the Philippines.

While he got marked reduction in the quantity of eggs in the dejecta, he likewise obtained some unfavorable effects on the host particularly severe flatulence which, fortunately, subsided in about an hour. Alessandrini (1908), however, observed differently. Using also extract of male fern in two severely infected sheep, he got a disheartening result—the death of both parasites and hosts. In the same species of animal Railliet, Moussu, and Henry (1911) used 5 grams of the ethereal extract in 25 cc of oil given in from 1 to 4 doses on successive days. Finding it effective, they suggested its use at the dose rate of 1 gram of the extract per 5 kilos of body weight. Montgomerie (1925) found oleoresin of aspidium in milk an efficient flukecide for the adult worms, but is rather ineffectual for the immature parasites.

In cattle Borini (1911) tried the ethereal extract of male fern consistently getting favorable results in light infections but not in heavily infected cases with cachexia.

After these early experiments, a number of proprietary products of male fern appeared in many European markets under the trade names of "distol" (manufactured in Hungary), "danistol" (believed to be similar to distol), "fasciolin," "avisciolina," "filmaron," etc. Distol was recommended by Marek (1917) and by Kraneveld (1925). Only lately Swanson and Goo (1938), Alicata, et al. (1940), and Alicata (1941) found it effective against fascioliasis in cattle, but the milk acquired a bitter salty taste that lasted for a few days. Danistol is much more expensive and yet no more effective than distol, according to Montgomerie (1926).

Other nonmale fern preparations had also been tried, like calomel, sodium salicylate, compounds of arsenic, phosphorus, mercury and antimony, tetrachlorethylene, carbon tetrachloride, kamala, hexachlorethane alone and the latter's combination with tetrachlorethylene, filicic acid, kamala extract, and inert ingredients, but, save for the last seven, all had been found ineffective. Carbon tetrachloride which gave satisfactory results to Ernst (cited by Chopra and Chandler, 1928) and to Montgomerie (1926) in sheep was considered by Hutyra and his associates (1938) and by Monnig (1938) to be dangerous for ruminants and rather toxic for cattle, producing central necrosis and fatty degeneration of the liver especially among fattened animals and those with hypocalcemia, in advanced pregnancy, and in lactation. Kamala, while effective, was

observed by Alicata, et al. (1940) and by Alicata (1941) to produce profuse and weakening diarrhea which lasted for as long as two weeks.

Hexachlorethane alone was well recommended by De Blieck and Baudet (1928) and by Noller (cited by Monnig, 1938) for cattle fascioliasis. While found to be highly efficacious by Hilz and Schauble in doses of 20 to 30 grams per 50 kilos live weight, according to Hall as cited by Alicata (1941), it was observed by Noller and by Alicata to cause colic in milch cows feed on concentrates, or when given in high concentrations. Marek (1926), Thienel (1927), and Alicata (1941) combined this flukecide with tetrachlorethylene, filicic acid, and kamala extract, respectively, while Vianello (1937), Pegreffi (1939), Rosenberger and Slesic (1942), and Olsen (1943, 1944) mixed it with inert ingredients. Olsen used hexachlorethane in aqueous suspension with bentonite as a drench which, although he claimed to have gotten highly encouraging results (91 per cent efficiency) over his one-day treatment for fascioliasis hepatica, was found in Hawaii that the "results with this method have not been very satisfactory" (Alicata in a personal communication to the writer January 12, 1946).

MATERIALS AND METHODS

The subjects for this study were forty-eight dairy cattle (mostly grades) and four Indian buffaloes belonging to the Swiss Dairy Farm at Caloocan, Rizal, Philippines. The concern had formerly about a hundred of these animals but many died of fascioliasis prior to the treatment. Hexachlorethane and kamala extract were given in capsules at the rate of 10 grams and 1.75 grams, respectively, for every 30 kilos of body weight. The total dose was divided into approximately equal quantities and was administered orally over two successive days following an overnight fasting (Table 1). Feed was likewise withheld at least three more hours after each dose. As it was thought that *therapia sterilisans magna* might be possible with a single treatment (for practical purposes), four of the cows were given the total amount only once (Table 2) instead of distributing it over a two-day period, as suggested by Alicata (1941). In two others the total dose was given daily for two consecutive days. Single injections of 20 per cent calcium-borogluconate solution were given the animals the better number of which were poor risks.

TABLE 1.—*Showing the effect on fascioliasis of the total amount of 10 grams hexachlorethane and 1.75 grams kamala extract per 30 kilos body weight equally distributed over a two-day period.*

Animal No.	Weight	Flukecide, first day		Flukecide, second day		Egg-count per gram of feces		Flukecide efficiency against mature flukes	Necropsy findings	Remarks
		Hexachlo-rethane	Kamala extract	Hexachlo-rethane	Kamala extract	Pre-treatment	Post-treatment			
	Kilos	*Grams*	*Grams*	*Grams*	*Grams*			*Per cent*		
22	263	43.80	7.66	43.80	7.66	110	22	80.00	Some adult flukes found.[a]	Lively, appetite good throughout. Slight diarrhea noted.
66	309	51.50	9.01	51.50	9.01	88	0	100.00	Negative for flukes; liver appeared normal.	Profuse diarrhea for 3 days. Appetite fair.
38	324	54.00	9.45	54.00	9.45	132	22	83.33	Some flukes found.[a]	Disintegrated flukes in feces after 3 days; no appetite and profuse diarrhea for 2 days.
67	253	42.15	7.37	42.15	7.37	44	0	100.00	Negative.	Disintegrated flukes seen in feces after 4 days. Lively; appetite fair.
27	276	46.00	8.05	46.00	8.05	44	0	100.00	Four immature flukes found.	Fair appetite; lively.
68	306	51.00	8.92	51.00	8.92	198	66	66.66	Many adult flukes found.[a]	Do.
32	277	46.15	8.07	46.15	8.07	220	44	80.00	Some adult flukes found.[a]	Fair appetite; slight diarrhea for 5 days.
57	293	48.65	8.48	48.65	8.48	66	0	100.00	Negative for flukes; liver appeared normal.	Good appetite.
43	288	48.00	8.40	48.00	8.40	22	0	100.00	do.	Do.
84	250	41.60	7.28	41.60	7.28	44	0	100.00	do.	Do.
86	243	40.50	7.08	40.50	7.08	88	22	75.00	Some adult flukes found.[a]	Fair appetite; lively.
72	321	53.50	9.36	53.50	9.36	44	0	100.00	Negative	Good appetite; slight diarrhea.
95	274	45.66	7.98	45.66	7.98	22	0	100.00	do.	Do.

41	247	41.15	7.20	41.15	7.20	66	0	100.00	do	Fair appetite; lively; slight diarrhea for 3 days.
30	257	42.80	7.49	42.80	7.49	66	22	66.66	Some adult flukes found.[a]	Good appetite; lively.
60	298	49.65	8.68	49.65	8.68	44	0	100.00	Negative.	Fair appetite; slight diarrhea for 6 days.
89	310	51.50	9.01	51.50	9.01	44	0	100.00	do	Profuse diarrhea noted; appetite poor.
83	293	48.80	8.54	48.80	8.54	22	0	100.00	do	Poor appetite for 2 days.
81	316	52.65	9.21	52.65	9.21	66	22	66.66	Some adult flukes noted.[a]	Fair appetite on day of treatment.
40	262	43.65	7.63	43.65	7.63	22	0	100.00	Negative.	Good appetite; disintegrated flukes seen in feces after 3 days.
88	241	40.15	7.02	40.15	7.02	22	0	100.00	Three young flukes found.	Fair appetite; lively.
96	339	56.50	9.88	56.50	9.88	22	0	100.00	Negative.	Lively; good appetite.
85	253	42.15	7.37	42.15	7.37	132	44	66.66	Some adult flukes noted.[a]	Good appetite.
92	326	54.30	9.50	54.30	9.50	22	0	100.00	Negative	Fair appetite.
73	293	48.80	8.54	48.80	8.54	44	0	100.00	Negative	Disintegrated flukes seen in stool after 2 days. Lively; good appetite.
28	260	43.30	7.57	43.30	7.57	88	22	75.00	Some adult flukes found.[a]	Good appetite.
24	338	56.30	9.85	56.30	9.85	22	0	100.00	Negative.	Diarrhea for 5 days; appetite poor.
26	259	43.15	7.55	43.15	7.55	22	0	100.00	Negative.	Fair appetite.
11	287	47.80	8.36	47.80	8.36	88	22	75.00	Some adult and immature flukes found.[a]	No appetite for a day; lively; slight diarrhea.
42	289	48.15	8.42	48.15	8.42	44	0	100.00	Negative.	No appetite for 2 days; lively.
45	250	41.60	7.28	41.60	7.28	110	22	80.00	Some adult flukes found.[a]	Good appetite.

TABLE 1.—*Showing the effect on fascioliasis of the total amount of 10 grams hexachlorethane and 1.75 grams kamala extract per 30 kilos body weight equally distributed over a two-day period*—Continued.

Animal No.	Weight	Flukecide, first day		Flukecide, second day		Egg-count per gram of feces		Flukecide efficiency against mature flukes	Necropsy findings	Remarks
		Hexachlorethane	Kamala extract	Hexachlorethane	Kamala extract	Pre-treatment	Post-treatment			
	Kilos	*Grams*	*Grams*	*Grams*	*Grams*			*Per cent*		
87	280	46.65	8.16	46.65	8.16	22	0	100.00	Negative.	Fair appetite; disintegrated flukes in feces seen after 3 days.
69	293	48.80	8.54	48.80	8.54	66	0	100.00	do.	Slight diarrhea for 4 days.
44	251	41.80	7.31	41.80	7.31	154	44	71.42	Some adult flukes found.[a]	Good appetite; slight diarrhea for 2 days.
39	247	41.10	7.20	41.10	7.20	110	22	80.00	do.	Good appetite; lively.
78	288	48.00	8.40	48.00	8.40	44	0	100.00	Negative.	Profuse diarrhea for 4 days.
63	269	44.80	7.74	44.80	7.74	66	0	100.00	do.	Do.
48	254	42.30	7.40	42.30	7.40	22	0	100.00	do.	Slight diarrhea for 3 days; good appetite.
25	293	48.80	8.54	48.80	8.54	44	0	100.00	do.	Good appetite.
46	301	50.15	8.77	50.15	8.77	44	0	100.00	do.	Profuse diarrhea for 2 days.
51	242	40.33	7.05	40.33	7.05	66	0	100.00	do.	Profuse diarrhea for 3 days.
14	248	41.30	7.22	41.30	7.22	110	22	80.00	Some adult flukes found.[a]	Lively; good appetite.
Buffalo 1	486	81.00	14.17	81.00	14.77	44	0	100.00	Negative.	Profuse diarrhea for 4 days; lively.
Buffalo 2	482	80.35	14.06	80.35	14.06	220	66	70.00	Some adult and immature flukes found.[a]	Slight diarrhea for 5 days.
Buffalo 3	507	84.50	14.78	84.50	14.78	66	0	100.00	Negative.	Slight diarrhea for 6 days; good appetite.
Buffalo 4	498	83.00	14.52	83.00	14.52	110	22	80.00	Some adult flukes found.	Slight diarrhea for 3 days; good appetite and lively.
Average anthelmintic efficiency								91.22		

[a] Only livers of animals with negative feces were meticulously examined postmortem to verify laboratory findings because a thorough inspection of these organs will result in their devaluation.

TABLE 2.—*Showing the effect on fascioliasis of the total amount of 10 grams kamala extract per 30 kilos body weight given only once or daily for two consecutive days.*

Animal No.	Weight	Flukecide, first day		Flukecide, second day		Egg-count per gram of feces		Flukecide efficiency against mature flukes	Necropsy findings	Remarks
		Hexachlorethane	Kamala extract	Hexachlorethane	Kamala extract	Pre-treatment	Post-treatment			
	Kilos	*Grams*	*Grams*	*Grams*	*Grams*			*Per cent*		
47	268	89.30	15.62	----------	----------	132	0	100.00	Negative for flukes.	Full dose given once, profuse diarrhea for a week; appetite good; lively.
35	262	87.30	15.27	----------	----------	154	----------	----------	All mature flukes disintegrating; liver appeared half-cooked, immature flukes unaffected.	Full dose given once, down and prostrate on the second day after treatment; profuse diarrhea, died two days thereafter.
21	238	79.30	13.87	----------	----------	132	----------	----------	do.	Full dose given once, down on fourth day after treatment, profuse diarrhea, died two days thereafter.
19	247	82.30	14.40	----------	----------	110	0	100.00	Negative for flukes.	Full dose given once, profuse diarrhea for 4 days; lively; appetite fair.
36	232	77.30	13.52	77.30	13.52	176	----------	----------	All flukes disintegrating, liver appeared half-cooked.	Emaciated animal; full dose given twice; down on the following day after last dose, died on 3rd day.
23	239	79.60	13.93	79.60	13.93	244	----------	----------	All flukes disintegrating, necrotic areas present, liver appeared half-cooked.	Full dose given twice, down on 3rd day, profuse diarrhea, died 2 days thereafter.

Precautions were taken to preclude the reinfection of the herd during the experiment.

The differential-egg-count test which is commonly employed in the determination of the anthelmintic efficacy of expedients (Moskey and Harwood, 1941), subsequently checked by necropsy findings, was used as the criterion for evaluating the efficiency of the hexachlorethane-kamala extract. Shortly before and a month after treatment, a 200-gram fecal sample was obtained rectally from each ruminant for three consecutive days and the samples were deposited in correspondingly labelled bottles. Those of the same subject were grouped together and after their thorough comminution the ova in each sample were counted, using the dilution-egg-count technic of Whitlock (1941), which is a modification of Gordon's and Whitlock's (1939). Briefly, the method was as follows: A 10-gram stool was placed in a bottle and enough water was added up to the 150-cc level. After thorough stirring, about 10-cc suspension was strained through an 18-mesh wire gauze and 0.5 cc of the latter was drawn into a tuberculin syringe. Saturated salt solution was subsequently drawn in until the contents reached the 1-cc mark. This was followed shortly by the suction of an air bubble with sufficient diameter capable of moving up and down freely when the syringe is lifted. Then an even suspension was secured by tilting the syringe up and down with the air bubble, the contents being agitated considerably. After about 0.2 cc as waste was withdrawn, and before the suspensoids could settle down, three 0.15-cc samples were immediately smeared on three slides. The eggs were now counted, and the average of all the egg-counts in the three smears multiplied by 200 gave the number of ova per gram of dung.

Three such counts were made for every sample collected from each subject prior to the treatment, and the average of all the nine counts was taken as the index of the quantity of eggs per gram of dejecta of that animal. Analogous counts were also made from the collections obtained a month after the medication, and, the difference between the pre- and the post-treatment egg-counts being known, it was then easy to determine the efficiency of the expedient by simple mathematical calculation.

Two months later, and following consultation with the writer who was not averse to the idea, the manager sent all the animals to the block, because he feared that they would only

get lost on account of the disorder then obtaining during the Japanese occupation. To the writer, this act was most welcome, because, aside from saving the concern from augmenting its losses, it also offered him the opportunity to examine the liver, thus enabling him to determine the effect of his treatment.

OBSERVATIONS AND RESULTS

The observations and results are presented in Tables 1 and 2. Table 1 shows the effect on fascioliasis of the total amount of 10 grams hexachlorethane and 1.75 grams kamala extract per 30 kilos body weight equally distributed over a two-day period. Table 2 shows the effect on fascioliasis of the total amount of 10 grams hexachlorethane and 1.75 grams kamala extract per 30 kilos body weight given only once or daily for two consecutive days.

DISCUSSION

The total dose of 10 grams hexachlorethane and 1.75 grams kamala extract per 30 kilos body weight administered over a two-day period was apparently well tolerated by the test subjects (Table 1), but not so with the bigger dosages especially when dealing with debilitated animals (Table 2). Encouraging results were obtained with the former dose, and from forty-six animals parasitized with either one or both of *Fasciola hepatica* and *F. gigantica,* the average anthelmintic efficiency obtained was 91.22 per cent. The efficiency, however, seems to depend on the intensity of infection. Adult worms were conspicuous by their absence in the liver of posted animals having pretreatment counts as high as 44 eggs per gram of dung. This egg level is higher than that observed by Alicata (1941) who found "that in cases where the egg count was below 35 eggs per gram of feces, this dosage completely eliminated all adult flukes, as evidenced by subsequent absence of fluke eggs in the feces." Where the egg count per gram was as high as 66 eggs, the efficiency in eight animals varied from 66.66 to 100 per cent, with an average of 91.66 per cent. The average in four cases with 88 eggs per gram of dejecta was 81.25 per cent, and 80 per cent in five cases where the count per gram was as high as 110 ova. Due to the paucity of data, no mention could be made of the cases with counts beyond 110 eggs per gram of stool.

Adult flukes undergoing degeneration were found in the feces of animals treated 2 to 4 days previously. Young flukes seem

not to be affected by the expedient for, with reinfection forestalled, worms short of gravidity were still seen in the livers of cows number 27, 88, and 11 and from the same organ of buffalo number 2 killed two months after deworming. Furthermore, live flukes in a much younger state of development than the preceding were encountered along with adult parasites that were undergoing disintegration in one of the animals (cow number 35) that died on the fourth day following the administration of a big dose (Table 2).

It may be recalled that Olsen in 1941 stated that he obtained 91 per cent efficiency over his one-day treatment using hexachlorethane in aqueous suspension with bentonite as a drench (*vide supra*), adding that "treatments of cattle with hexachlorethane alone, or hexachlorethane and kamala, in capsules, did not give results superior to the drench method." On the other hand, Alicata [2] in a personal communication to the writer mentioned that results obtained with the Olsen's method "have not been very satisfactory." Results obtained by the writer with hexachlorethane-kamala extract in capsules against fascioliasis hepatica and/or fascioliasis gigantica were just as encouraging as that obtained by Olsen against the former scourge alone using hexachlorethane-bentonite suspension.

The treatment with hexachlorethane (carbon trichloride) and kamala extract occasioned a temporary reduction of milk for a few days; the extract caused a slight to profuse diarrhea which lasted from 2 to 6 days.

The counts per gram of stool in the fifty-two animals ranged from 22 to 244 eggs. Seventeen of them had over 100 ova, the minimum egg-per-gram level set by Taylor (1939) as dangerous for bovine fascioliasis. Owing to the intensity of their infections, six heavily infected cases were given bigger amounts of the flukecide (Table 2) in an attempt to effect a "knock-out" dose without, at the same time, impairing their health. Of the four ruminants that were given the total dose once, two died with all the adult flukes undergoing disintegration; the remainder had livers as clean as a noninfected organ on slaughter. The two emaciated animals given the total amount of the expedient daily for two consecutive days died

[2] Alicata probably dealt with fascioliasis gigantica which is the infection in Hawaii.

together with their parasites three to five days after treatment. The worms were found disintegrated on autopsy.

The expedient seems to be effective also against the conical flukes (*Cotylophoron cotylophorum, Paramphistomum cervi,* etc.) whose eggs were drastically reduced after the medication. The stomachs of the ruminants, however, were not examined, hence the writer could not ascertain whether or not these amphistomes were only sterilized. The effect of hexachlorethane and kamala extract against them deserves further scrutiny.

SUMMARY

The results of treatment with hexachlorethane and kamala extract against fascioliasis hepatica and/or fascioliasis gigantica in fifty-two animals are given in this paper.

In dosis of 10 grams hexachlorethane and 1.75 grams kamala extract per 30 kilos body weight equally distributed over a two-day period, encouraging results were obtained (91.22 per cent efficiency), and the animals generally tolerated the drug well, but not so when the total dose was given only once or when given daily for two consecutive days.

The anthelmintic efficiency of the expedient seems to depend on the intensity of infection. The egg-per-gram level which revealed the absence of worms at autopsy was 44 ova.

Young flukes seem not to be affected by the treatment.

Hexachlorethane-kamala extract combination seems to be a promising remedy also against the conical flukes (*C. cotylophorum, P. cervi,* and others). The effect of this drug against these amphistomes deserves further study.

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SOME FACTORS AFFECTING THE PRODUCTION OF DEXTRAN FROM CANE SUGAR BY LEUCONOSTOC DEXTRANICUM [1]

By LUZ BAENS-ARCEGA
Of the Bureau of Science, Manila

and

FLAVIANO M. YENKO
Formerly of the Bureau of Science, Manila

TWO PLATES

The production of dextran gum from sucrose (cane sugar) by means of certain organisms has been accomplished by various investigators. The best yield so far recorded is 25 per cent. It required about 2 weeks to produce this amount which is considerably below the theoretical yield of 47.37 per cent.

Recently we had occasion to make some of this gum and incidentally studied the experimental conditions for preparing it. We were successful in working out a method that required only 2 days to produce a theoretical yield. Our results are recorded in this report.

When sucrose ($C_{12}H_{22}O_{11}$) is hydrolyzed it is converted into the two simpler sugars—dextrose ($C_6H_{12}O_6$) and levulose ($C_6H_{12}O_6$). Dextran is a sugar anhydride gum [2] that yields dextrose sugar on hydrolysis. Fernbach, Schoen and Hagiwara,[3] working with *Leuconostoc dextranicum* de Beijerinck, made dextran from sucrose. They found that the organism produced gum only from sucrose, and not from sucrose which was previously hydrolyzed into simpler sugars by acids or invertase, and also not from the isolated dextrose or levulose. Based on the amount of sucrose employed the yield obtained was only about 10 per cent.

[1] This paper was ready for publication September, 1941.

[2] Thaysen, A. C., and L. D. Galloway. The Microbiology of Starch and Sugars (1930) 183.

[3] Comptes Rendus de la Societe de la Biologie 92 (1925) 1418.

Levulosan is also a sugar anhydride gum similar to dextran. It yields levulose sugar on hydrolysis. In 1912 Fernbach and Schoen[4] produced a theoretical yield of levulosan from sucrose by means of bacteria. They showed that the bacteria were able to produce the gum only from nascent levulose that is liberated by the organisms in the hydrolysis of sucrose. The production of levulosan from the levulose part of the sucrose molecule naturally suggested the preparation of dextran from the dextrose portion of the sucrose molecule.

Carruthers and Cooper[5] studied extensively the nutrient requirements and accessory growth factors necessary for a large-scale production of dextran by *Leuconostoc dextranicum* (*Betacoccus arabinosaceous haemolyticus* Kluyver). They found that only a very small amount of gum can be synthesized from glucose alone. The failure to produce dextran from glucose could not have been due to the inhibitory effect of acid produced in the reaction, for the pH of the glucose and sucrose cultures after a week's incubation was practically the same (about 4). After incubating the organisms for 2 weeks at 30° C. with the medium which they developed, these workers were able to synthesize about 25 per cent of dextran based on the sucrose employed. The largest quantity of medium they used for a large-scale production of dextran was 5 liters which was divided into 800-cc portions.

Stacey and Youd[6] followed the method of Carruthers and Cooper for a large-scale production of dextran gum and used the same strain of *Leuconostoc*. They observed unforeseen and inexplicable irregularities in the activity of the organisms. There were growth and also increased viscosity in some flasks, while in others which were prepared in the same manner there was very little or no gum formation. The irregularity became particularly marked when the volume of the culture medium was increased beyond 100 cc and after repeated subculturing of the organisms.

In conformity with the findings of Carruthers and Cooper, Stacey and Youd observed that the acid produced did not have any inhibitory effect on the formation of dextran inasmuch as the pH values of the medium were identical in both viscous and weak cultures during and after growth. Sterilization of sucrose and peptone solutions separately, followed by aseptic

[4] Comptes Rendus Hebdomadaires des Seances de l' Academie des Sciences **155** (1912) 84.

[5] Biochem. Jour. **30** (1936) 1001.

[6] Biochem. Jour. **32** (1938) 1943.

mixing before inoculation, gave increased yields of dextran, but the growth was still irregular.

Stacey and Youd developed a medium for a large-scale production of dextran by using commercial maple syrup for accessory growth substance and for increasing the concentration of sucrose to 20 per cent. The mixed medium was divided into 100-cc portions contained in 500-cc flasks. After they were inoculated with organisms (48 hours old) the cultures were incubated for 10 days at 30° C. The yield of crude gum was 25 per cent based on the sucrose employed.

EXPERIMENTAL PROCEDURE

The *Leuconostoc dextranicum* (*Betacoccus arabinosaceous haemolyticus* Kluyver) which we used in our studies was kindly given to us by Prof. H. J. Kluyver, of Holland. The composition of our culture medium was similar to that developed by Carruthers and Cooper.[7] Our basal medium, designated as medium No. 9 in the experiments, was prepared as follows:

Substitute	Per cent
Sucrose	10.00
Peptone-salt solution:	
Peptone	0.10
Disodium phosphate	0.10
Potassium chloride	0.10
Sodium carbonate	0.013
Distilled water.	
Molasses:	
(50 per cent solution) 5 cc for every 800 cc of the combined liquid medium.	

Double strengths of sucrose (20 per cent) and peptone-salt (0.20 per cent) solutions were sterilized separately in suitable containers. Equal volumes of the cooled solutions were mixed aseptically thus giving a 10 per cent sucrose and 0.10 per cent peptone-salt concentration. To every 800 cc of this mixture 5 cc of molasses (50 per cent) were added.

Preparation of dextran.—The general method for preparing dextran was as follows: Portions (15 cc) of the sucrose-peptone-salt solution containing molasses were poured into sterile calibrated test tubes. The pH of this medium was found by determination to be 7.30–7.70 which was most suitable for the bacteria. Each tube was inoculated with a loopful of

[7] Biochem. Jour. 30 (1936) 1001.

the organisms. After incubation for a definite time the amount of dextran synthesized was determined by adding 3 volumes of alcohol to 1 volume of culture in tarred containers. The gum separated as a whole mass and very little precipitated as powder. The alcoholic mixture was set aside overnight; the supernatant liquid was decanted and the gum was dried in an oven at 100° C. The weight was taken as that of the crude dextran.

The theoretical yield of dextran which can be made from the glucose part of the sucrose molecule may be calculated from the following equations:

$$\underset{\text{sucrose}}{C_{12}H_{22}O_{11}} + H_2O \rightarrow \underset{\text{glucose}}{C_6H_{12}O_6} + \underset{\text{levulose}}{C_6H_{12}O_6}$$

$$\underset{\text{glucose}}{C_6H_{12}O_6} \rightarrow \underset{\text{dextran gum}}{(C_6H_{10}O_5)\,N} + H_2O$$

The molecular weight of sucrose is 342 and that of dextran, 162. Sucrose (342 grams) should yield 162 grams of dextran gum, or a calculated yield of 47.37 per cent.

Effect of water used.—In the first series of experiments medium No. 9 (with distilled water) was used. The tubes were inoculated with organisms (2 days old) and incubated at 30° C. The yield of dextran was low and the growth of the *Leuconostoc* was irregular. Tap water was then used as solvent instead of distilled water in medium No. 9 and the solution was labelled medium No. 10 in the experiments. For comparison two sets of test tubes containing media Nos. 9 and 10, prepared at the same time, were inoculated with the organisms and incubated at 30° C. The amount of dextran synthesized in each medium was determined at various intervals. Results are recorded in Table 1.

TABLE 1.—*Effect of using tap water instead of distilled water in the medium.*

Medium		Gum and pH determined after incubation at 30°C.							
		1 day		2 days		3 days		14 days	
Number	pH.	Gum.	pH.	Gum.	pH.	Gum.	pH.	Gum.	pH.
		Per cent		*Per cent*		*Per cent*		*Per cent*	
9	7.7	4.9	6.50	10.9	3.95	11.1	3.70	11.2	3.20
10[a]	7.65	3.5	6.90	31.4	4.30	32.1	4.30	36.9	3.90

[a] The composition and preparation of medium No. 10 were the same as those of No. 9 except that tap water was used instead of distilled water.

The figures (Table 1) show that the yield of dextran from tap water was higher than that from distilled water, but the theoretical yield was not obtained. The difference in the yields of gum could not have been due to the initial pH of the media as it was practically the same in both cases. The results of the experiments, which will be discussed later, show that the difference was due to certain minerals present in tap water.

Influence of temperature.—To ascertain some other factors which might make possible the complete polymerization of the glucose part of the sucrose molecule the influence of temperature on the activity of the organisms was studied.

One batch of test tubes containing medium No. 10 (pH 7.35) was inoculated with organisms (2 days old) and divided into 3 sets. One set was incubated at 30° C. for one day to allow the organisms to grow and multiply and then incubated at 10° C. The second set of cultures was incubated at 27° C., and the third at 30° C. The amount of gum produced at different incubation temperatures was determined daily. The results are shown in Table 2.

TABLE 2.—*Influence of incubation temperature on the production of dextran.*

Temperature	Gum and pH determined after incubation							
	1 day		2 days		3 days		8 days	
	Gum.	pH.	Gum.	pH.	Gum.	pH.	Gum.	pH.
°C	*Per cent*		*Per cent*		*Per cent*		*Per cent*	
10	19.8	4.35	30.2	4.30	31.8	4.05	48.2	3.86
27	24.7	4.45	49.4	4.10	49.4	3.90	50.5	3.90
30	19.8	4.35	33.8	3.90	36.1	3.67	36.2	3.46

NOTE.—Medium No. 10 (pH 7.35) was used. The culture incubated at 10°C. was first incubated at 30°C. for one day and then transferred at 10°C.

The results (Table 2) show that the theoretical yield of dextran was obtained after a period of 2 days when the organisms were incubated at 27° C. After 8 days, however, the yield of gum from the culture incubated at 10° C. was as high as that kept at 27° C. Both cultures were highly viscous and difficult to pour but the tube kept at 27° C. was more opaque than that incubated at 10° C. The tube kept at 30° C., which was whitish yellow and not very viscous, gave only 36.2 per cent of gum after 8 days of incubation period. These data show that 27° C. is a very suitable temperature for the synthesis of dextran by *Leuconostoc dextranicum.* Longer periods of incubation did

not materially increase the yield of dextran. The amount (49.4 per cent) of crude gum obtained after 2 days of incubation at 27° C. was higher than that of the theoretical yield. This was due, perhaps, to some levulose which was enclosed within the mass of gum when precipitated with alcohol and also, possibly, to the residue of liquid left in the container after decantation.

Age of inoculum.—To determine the proper age of the inoculum, organisms from one culture were inoculated daily in medium No. 10 contained in test tubes and incubated at 27° C. The quantity of gum and pH were determined after 2 days of incubation period, as shown in Table 3.

TABLE 3.—*Age of inoculum and production of dextran.*

Age	Gum and pH determined after 2 days incubation at 27°C		Age	Gum and pH determined after 2 days incubation at 27°C.	
	Gum.	pH.		Gum.	pH.
Days	*Per cent*		*Days*	*Per cent*	
1	50.2	4.45	8	36.6	4.60
2	49.6	4.35	9	35.7	4.75
3	50.1	4.40	10[a]	35.0	4.60
4	50.0	4.30	11	34.0	4.65
5	49.7	4.35	12	27.3	4.65
6	50.0	4.35	13	26.1	4.70
7	49.0	4.20	14	14.2	4.80

[a] Medium No. 10 (pH 7.45) was used.

The results (Table 3) show that an inoculum from 1 to 7 days old can produce the theoretical yield of dextran in 2 days. Older inocula require a longer period of incubation. It was observed, however, that organisms 2 days old gave the best results.

Generations of organisms.—When the organisms were kept for months before being transferred to a new medium, they were too weak to synthesize the theoretical yield of dextran even after very long periods of incubation. Subsequent transfers in liquid medium did not activate them, but when they were grown first in solid medium (medium No. 10 plus 2 per cent agar) and then transferred to liquid medium they became very active again. The first culture in liquid medium, ino-

culated with organisms from a solid medium, was designated as "generation." Subsequent inoculations from one liquid medium to another were designated as "generation 2" and so on (Table 4).

TABLE 4.—*Generations of organisms.*

Generation	Gum and pH determined after 2 days incubation at 27°C.		Generation	Gum and pH determined after 2 days incubation at 27°C.	
	Gum.	pH.		Gum.	pH.
	Per cent			*Per cent*	
1	50.6	4.22	15	47.7	4.30
2	49.7	4.44	16	49.6	4.30
3	48.1	4.40	17	48.7	4.20
4	49.3	4.30	18	48.2	4.35
5	48.4	4.35	19	48.3	4.20
6	48.8	4.36	20	49.1	4.35
7	48.9	4.30	21	48.2	4.30
8	49.9	4.43	22	48.4	4.35
9	48.8	4.51	23	49.6	4.35
10	48.3	4.30	24	49.8	4.30
11	48.3	4.30	25	48.1	4.35
12	48.7	4.36	26	49.2	4.30
13	49.0	3.30	27	49.7	4.35
14	48.1	4.25	28	50.0	4.40

NOTE.—The age of the inoculum was 2 days in all cases.

The data in Table 4 show that subsequent transfers of the organisms in liquid medium did not weaken them nor reduce their ability to polymerize glucose provided the age of the inoculum was 2 days.

Composition of tap water.—Tables 1, 2, and 3 show that by using tap water as solvent, incubating the organisms at 27° C., and using an inoculum 2 days old, the maximum (theoretical) amount of dextran can be produced in 2 days. Analysis of the tap water was obtained from the Metropolitan Water District in order to ascertain the mineral matter which served as nutritive substances for the microörganisms. Table 5 gives the composition of the tap water used in the experiments. Since calcium and magnesium are important mineral consti-

tuents for the metabolism of microörganisms it was thought that perhaps they were responsible for the increase in the amount of gum synthesized by the organisms when tap water was used as solvent.

TABLE 5.—*Chemical analysis of tap water in Manila.*[a]

	p. p. m.
Turbidity	0.15
Color	nil
pH	7.3
Total solids	82.0
Silica (SiO_2)	19.0
Iron and aluminum oxides (R_2O_3)	2.0
Iron (Fe)	traces
Aluminum (Al)	1.0
Calcium (Ca)	13.8
Magnesium (Mg)	4.5
Total alkalinity ($CaCO_3$)	41.0
Acidity (CO_2)	1.5
Bicarbonates (HCO_3)	50.0
Total hardness ($CaCO_3$)	53.0
Sulphates (SO_4)	9.2

[a] This analysis was made in the laboratory of the Balara Filters, Metropolitan Water District.

Calcium and magnesium.—To medium No. 9 (made with distilled water) was added calcium lactate, equivalent to the amount of calcium in tap water. This solution was designated as medium No. 16. To another portion of medium No. 9, magnesium sulphate equivalent to the quantity of magnesium in tap water was added and the solution labelled medium No. 17. To a third portion of medium No. 9 the same amounts of calcium lactate as in medium No. 16 and magnesium sulphate as in medium No. 17 were added together and the solution labelled medium No. 18.

For comparison sets of test tubes containing media Nos. 9, 10, 16, 17, 18 were inoculated with organisms, 2 days old, and incubated at 27° C., and the gum and pH were determined daily. The results are recorded in Table 6.

TABLE 6.—*Calcium and magnesium in the production of dextran.*

Medium No.	Initial pH of medium	Gum and pH determined after incubation at 27°C.					
		1 day		2 days		5 days	
		Gum.	pH.	Gum.	pH.	Gum.	pH.
		Per cent		*Per cent*		*Per cent*	
9	7.53	18.7	4.76	31.3	4.35	31.9	4.00
10	7.45	31.5	4.75	49.0	4.30	49.3	4.25
16	7.60	29.6	4.66	43.9	4.15	44.2	3.95
17	7.50	26.0	4.60	35.2	4.20	35.3	3.85
18	7.35	30.9	5.61	48.3	4.30	48.3	4.10

NOTE.—Medium No. 9 was composed of 10 per cent sucrose; 0.10 per cent disodium phosphate, potassium chloride and peptone; and 0.013 per cent of sodium carbonate dissolved in distilled water. To every 800 cc of the medium 5 cc of molasses (50 per cent) was added.

Medium No. 10 was the same as medium No. 9 except that tap water was used instead of distilled water.

Medium No. 16 was medium No. 9 plus 0.0106 per cent calcium lactate.

Medium No. 17 was medium No. 9 plus 0.00456 per cent of magnesium sulphate.

Medium No. 18 was medium No. 9 plus 0.0106 per cent of calcium lactate and 0.00456 per cent of magnesium sulphate.

Table 6 shows that after 2 days the theoretical yield of dextran was obtained from medium No. 10 while only 31.3 per cent was obtained from medium No. 9. Addition of calcium to medium No. 9 (giving medium No. 16) increased the yield to 43.9 per cent. The addition of magnesium alone to medium No. 9 (giving medium 17) raised the yield to 35.2 per cent. When calcium and magnesium were added together to medium No. 9 (giving medium 18) the yield of dextran was increased by 17 per cent. This is about equal to the sum (16.5 per cent) of the increases due to calcium and magnesium (media Nos. 16 and 17) added separately. Calcium and magnesium appear to be essential mineral factors in the synthesis of dextran from sucrose by *Leuconostoc dextranicum.*

Importance of nascent dextrose.—A sample of dextrose crystals prepared by the Insular Sugar Refining Company, Manila, was kindly presented to us by the superintendent, Mr. J. E. Mahoney. This sample was used in 5 and 10 per cent concen-

trations instead of sucrose in some of our media. The tubes containing the media were inoculated with organisms 2 days old, and the cultures were incubated at 27° C. After 2 days there was no gum formation. The cultures were further incubated for a period of one week and there was still no evidence of dextran formation. These results confirm the findings of Fernbach, Schoen, and Hagiwara [8] and also of Carruthers and Cooper [9] that dextran can be synthesized only from nascent glucose which is liberated from sucrose by the organism itself.

Comparative dextran production.—Comparative results obtained by different investigators on the production of dextran are given in Table 7.

TABLE 7.—*Comparative results obtained by different investigators on the production of dextran.*

Investigators	Incubation		Yield of crude dextran[a]
	Temperature	Period	
	°C.	*Days*	*Per cent*
Fernbach, Schoen, and Hagiwara (1925)[b]	----------	----------	10
Carruthers and Cooper (1936)[c]	30	14	25
Stacey and Youd (1938)[c]	30	10	25
Baens-Arcega and Yenko (1941)[c]	27	2	47.5–50.6

[a] The yield of crude dextran was computed on the amount of sucrose employed.
[b] *Leuconostoc destranicus* de Beijerinck was used.
[c] *Leuconostoc dextranicum* (*Betacoccus arabinosaceous haemolyticus* Kluyver) was used.

The data given in Table 7 show that Fernbach, Schoen, and Hagiwara obtained 10 per cent of dextran based on the sucrose employed. Carruthers and Cooper, as well as Stacey and Youd, succeeded in increasing the yield to 25 per cent after incubating the organisms for about 2 weeks. In our investigations we produced in 2 days 47.5–50.6 per cent of dextran, which is about the theoretical yield, by incubating the organisms at 27° C., and using our medium. The same yield was obtained when we worked with a fairly large volume of medium (50 liters at one time) distributed in 4-liter Erlenmeyer flasks.

Appearance of the organisms.—Smears of the organisms were stained in the following manner:

A loopful of diluted culture was placed on a clean slide, smeared, and fixed by drying over a small flame. It was

[8] Comptes Rendus de la Societe de la Biologie 92 (1925) 1418.
[9] Biochew. Jour. 30 (1936) 1001.

stained with carbol fuchsin solution for 2 to 5 minutes with the aid of heat. The stained organisms were rinsed with distilled water and dried over a flame. A loopful of saturated nigrosine NB solution was placed on one end of the slide and spread over the smear with the aid of the edge of another slide. Rapid drying was necessary to avoid decolorizing the organisms.

Under the high-power objective of the microscope the organisms appeared red surrounded by huge white capsules against a bluish background. They appeared singly, sometimes in diplos (pairs) and occasionally in short chains. The capsules of the organisms grown in solid medium were larger (Plate 1, fig. 2) than those grown in liquid medium (Plate 1, fig. 1).

When seen under the oil-immersion lens (Plate 2, figs. 1 and 2) two or more organisms were often found enclosed within the capsule. Capsules of organisms grown in solid medium contained more cells (Plate 2, fig. 2) than those grown in liquid medium (Plate 2, fig. 1). This fact recalls the observation of Mendes, as cited by Taar and Hibbert,[10] that inside the gelatinous capsules of *Leuconostoc mesenteroides* small cells were able to multiply by fission. This observation contributes additional and more conclusive evidence supporting the assumption that the mucilaginous fermentation results from the activity of the microörganisms.

Since the individual organisms enclosed within the capsules were clearly defined only under the oil-immersion lens, measurements of the organisms grown in liquid medium were made under this magnification. The cells within the capsules had an average of 0.9 micron in diameter. The size of the capsules varied with the number of organisms enclosed. Measurements of capsules enclosing single cells were taken. These capsules had an average size of 2.6 microns in width and 3.5 microns in length.

The gum was purified from the thick medium by precipitating it with alcohol. The white mass was dissolved in water, precipitated with alcohol a second time, and dried in a vacuum oven. A small portion of the purified gum was dissolved in water and smears were stained. The same capsulated organisms were seen.

[10] Canad. Jour. of Res. 5 (1931) 419.

According to Jrgensen, Hansen, and Lund,[11] the slime capsule formed by *Betacocci* consists of a monosaccharide anhydride called dextran.

Bergey,[12] in describing the species of *Leuconostoc mesenteroides* (Cieukowski) Van Tieghem, states that the chains of these organisms are surrounded by a thick, gelatinous, colorless membrane consisting of dextran.

The capsules of *Leuconostoc dextranicum* may likewise be composed of dextran.

Capsule formation and temperature.—In our low-temperature experiments (Table 2) the organisms were first incubated at 30° C. for one day to allow them to grow and multiply. Very little change was noted in the inoculated medium which was not viscous and only slightly cloudy. The culture was then transferred to 10° C. After one day at this temperature it became very viscous and transparent. The viscosity would naturally suggest the formation of considerable gum; however, when precipitated with alcohol, the yield of dextran was only 30.2 per cent as the material was partly soluble in alcohol.

The low temperature might have stimulated the organisms to form a protective coating or capsule. This coating may have consisted of dextran together with a soluble constituent (an intermediate product in the synthesis of dextran). Attempts to observe the organisms at this stage were not successful as it was difficult to stain the capsules.

The synthesis of dextran proceeded slowly and after 8 days at 10° C. the yield gradually increased to 48.2 per cent, which is about the theoretical amount.

A very suitable temperature for these organisms is apparently 27° C. When they were incubated at this temperature for 2 days 49.4 per cent of dextran was obtained. Under these conditions the organisms were not exposed to an unfavorable low temperature which might cause a retarding action. The culture was opaque and not thick as in the low-temperature experiment. The main activity at the optimum temperature is the synthesis of dextran.

[11] Jrgensen, A., A. Hansen, and A. Lund. Microörganisms and Fermentation (1939) 336.

[12] Bergey, David H. Bergey's Manual of Determinative Bacteriology (1930) 64.

When the organisms were incubated at 30° C., the temperature was too high for the proper activity of the organisms since the amount of dextran synthesized was not as much as that formed at lower temperatures.

SUMMARY

Dextran is a gum synthesized from the glucose part of the sucrose molecule by *Leuconostoc dextranicum* (*Betacoccus arabinosaceous haemolyticus* Kluyver).

The experimental conditions for the preparation of dextran from sucrose were investigated.

A suitable medium for the microörganisms to produce the theoretical yield (47.37 per cent) was developed. This medium consisted essentially of solutions of sucrose, peptone, alkali and alkali earth salts with a trace of molasses.

The optimum temperature for the production of dextran was found to be 27° C.

Experiments showed that an inoculum 1 to 7 days old can produce the theoretical yield of dextran in 2 days when the organisms were incubated at the optimum temperature.

Weakened organisms may be activated by growing them in a solid medium and then transferring them to a liquid medium.

Subsequent transfers of the microörganisms in liquid medium did not affect their activity provided the age of the inoculum was 2 days.

Tap water gave better results for preparing the medium than distilled water. The calcium and magnesium in tap water were found to be necessary nutrient factors for *Leuconostoc* in the synthesis of dextran.

Our experiments showed that dextran can be synthesized only from nascent glucose which is liberated from sucrose by the organism itself. When dextrose was used instead of sucrose, as carbohydrate material in the medium, dextran was not produced.

Reference was made to the comparative results obtained by different investigators on the production of dextran.

Carruthers and Cooper were able to produce 25 per cent of dextran based on the amount of sucrose employed by incubating the microörganisms for 2 weeks.

By using our medium we succeeded in synthesizing the theoretical yield of dextran (47.37 per cent) in 2 days. The

largest volume of medium we employed at one time was 50 liters, distributed in 4-liter Erlenmeyer flasks.

Photomicrographs of the stained capsules of *Leuconostoc*, grown in liquid and solid media, as observed under the high-power and also the oil-immersion objectives, were made. The capsules contained one or more cells as observed under the oil-immersion lens. Those enclosing single cells of organisms grown in liquid medium had an average size of 2.6 microns in width and 3.5 microns in length.

Our investigation indicates that the capsule is probably composed of dextran.

ILLUSTRATIONS

PLATE 1

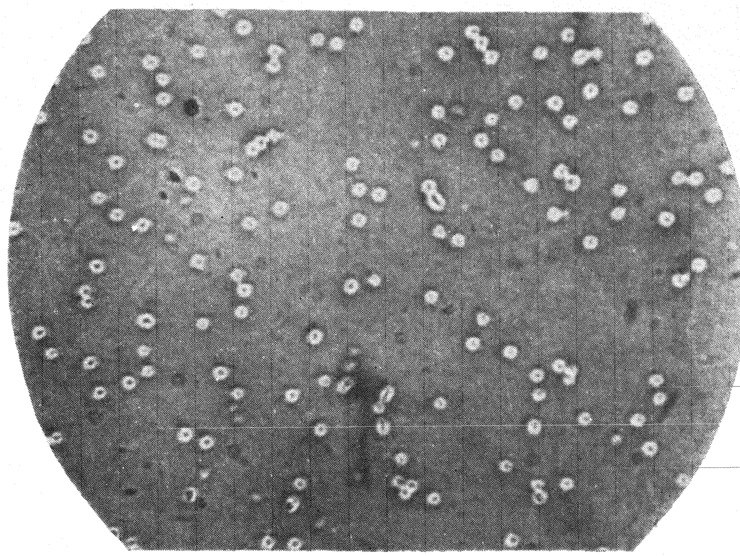
FIG. 1. *Leuconostoc dextranicum* grown in liquid medium as seen under the high-power objective; × 700.

2. *Leuconostoc dextranicum* grown in solid medium as seen under the high-power objective; × 625.

PLATE 2

FIG. 1. *Leuconostoc dextranicum* grown in liquid medium as seen under the oil-immersion lens; × 1,510.

2. *Leuconostoc dextranicum* grown in solid medium as seen under the oil-immersion lens; × 1,100.



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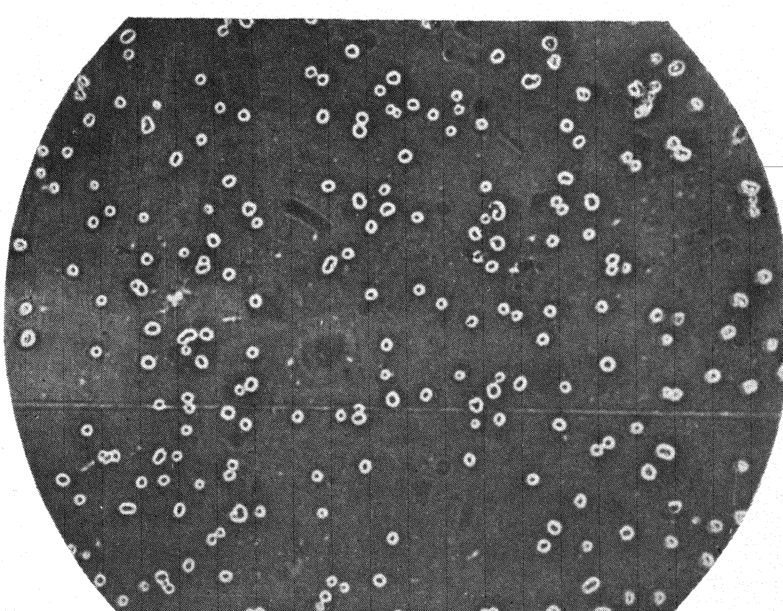

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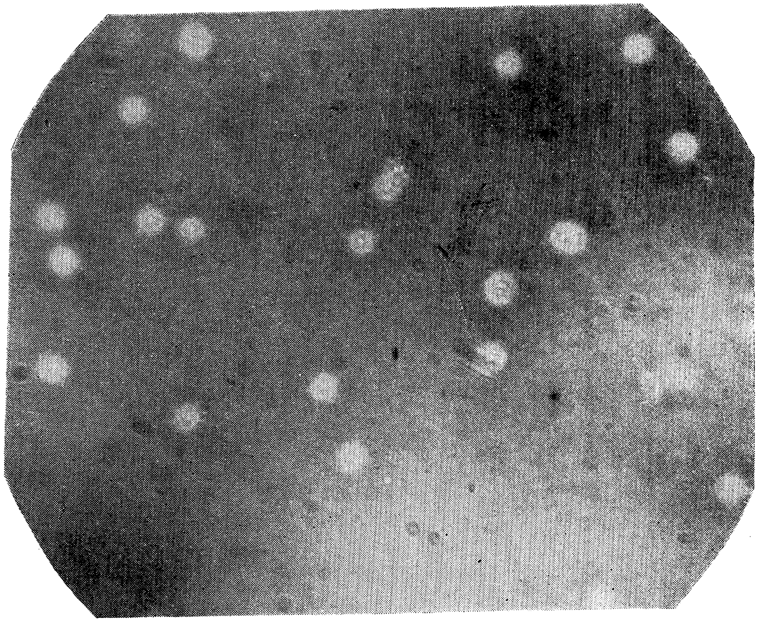
PLATE 1.



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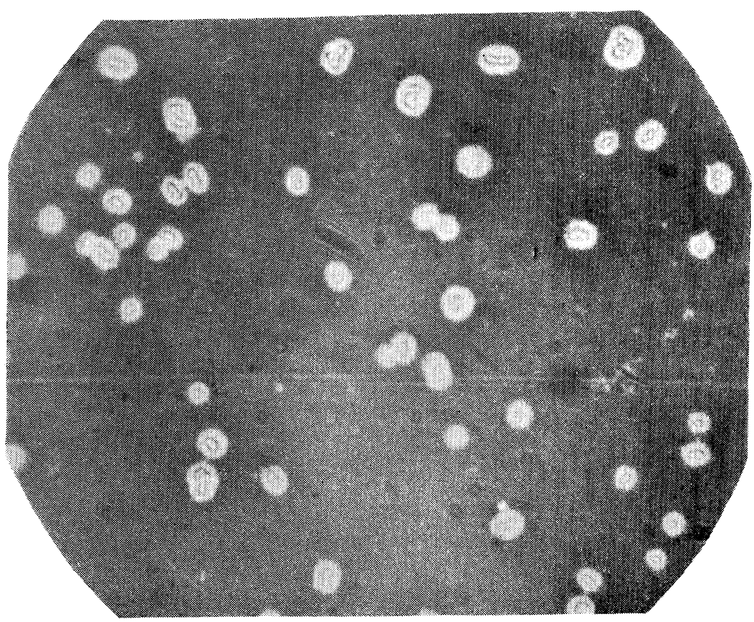

2

PLATE 2.

JATROPHA CURCAS LINN. (TUBA) AS A SOURCE OF NATURAL DYE [1]

By MAGDALENA R. ALDE, FRANCISCO AGCAOILI, and ROSA J.-COCHICO

Of the Bureau of Science, Manila

Jatropha curcas Linn., known as *tuba* in Tagalog, *taua-taua* in Ilocano, *tuba-tuba* in Visayan, is found in thickets and hedges throughout the Philippines.[2] It is common all the year in and about towns, and has been used for various purposes. The natives make use of the oil from the nuts for lighting their houses. It has been found also that almost all parts of this plant could be used for medicinal purposes.[3] It was observed that the decoction from the leaves and branches which were used for curing purposes, left a more or less permanent stain on the cloth. This fact has led the writers to study it as a source of natural dye, and to determine the proper method of applying the dye to ensure evenness and fastness qualities so that our local weavers and dryers can utilize it as a substitute for synthetic dyes.

METHODS OF EXTRACTION

Two methods of extraction, the simplest possible in order to make it easy for local dyers to apply them in their respective localities, were tried in extracting the coloring matter from the leaves and stems of the tuba plant. These methods are as follows:

Procedure 1.—The leaves and tender stems of the tuba were boiled for 4 hours. The solution was filtered through a cheesecloth and later concentrated into a syrupy consistency

[1] This paper was started before the outbreak of the war, but owing to a number of circumstances its completion has been delayed.

[2] Merrill, Elmer D., Flora of Manila (1912) 290.

[3] Brown, William H., Minor Products of Philippine Forests 3 (1921) 200.

by evaporation. The concentrate was a yellowish-olive syrupy substance.

Procedure 2.—The same procedure as in 1 was followed with the exception that the evaporation was continued to dryness. The concentrate was further dried in an oven. The dried extract obtained was in the form of blackish-brown lumps.

The extract obtained from the above procedures, however, included some impurities in it. In the succeeding experiments it was used in the dyeing of cotton. Several ways of applying it to cotton were tried, and the dyed material was tested for its fastness properties.

PROPERTIES OF THE EXTRACT

The dried extract has a blackish-brown appearance and is in the form of lumps. It is soluble in water, and readily soluble in hot water, having a brownish color in solution. When hydrochloric acid and sulfuric acid were added to the extract, its color is slightly changed. With sodium hydroxide the color turns deep brown and the extract is more readily soluble by its presence.

PRELIMINARY TREATMENT OF COTTON

Raw cotton goods contain waxes, serecins, oils, and other impurities. These impurities must be removed before the cotton goods are dyed, if good penetration and level dyeing are to be obtained.

The cotton yarn is scoured or boiled in a bath containing 10 per cent sodium carbonate (2 per cent sodium hydroxide can also be used) on the weight of the material. The material is worked in this bath for 2 hours or left overnight in the above solution after thorough wetting with water. It is then rinsed well with water and hydroextracted.

METHODS OF DYEING

Various methods of applying the natural dyes on cotton were tried. These dyes gave different shades of tan and brown. Both extracts obtained by the two procedures of extraction were used and the dyed material was tested for its fastness properties.

DYEING WITH THE TUBA CONCENTRATE

METHOD 1

The scoured cotton yarn was dyed in a bath containing the tuba concentrate diluted with water enough to cover the yarn. This was brought to the boil and worked for ¾ to 1 hour. Then the dyed yarn was hydroextracted.

Several after-treatments were tried on the dyed material.

After-treatment (*a*).—The dyed yarn was after-treated with a warm solution containing 3 per cent alum for 30 minutes. Then it was rinsed and dried.

After-treatment (*b*).—The dyed yarn was immersed in a solution containing 4 per cent lead subacetate for half an hour and subsequently rinsed and dried.

After-treatment (*c*).—The dyed yarn was immersed in a solution containing 1 per cent copper sulphate and 1 per cent potassium dichromate for half an hour. Then it was rinsed and dried.

After-treatment (*d*).—The dyed yarn was immersed in a warm bath containing 2 per cent ferric chloride for about 30 minutes. Then it was rinsed and dried.

After-treatment (*e*).—The dyed material was immersed in a bath containing 3 per cent sodium sulphide for 30 minutes, and then was rinsed and dried.

After-treatment (*f*).—The dyed material was immersed in a bath containing 3 per cent chromium fluoride for 30 minutes. Then it was rinsed and dried.

METHOD 2

The scoured yarn was dyed in a bath containing the tuba coloring matter [0.4 per cent sodium hydroxide and 10 per cent of common salt (sodium chloride)]. This was worked in the bath for ¾ to 1 hour and brought to the boil. Then it was hydroextracted.

After-treatment.—The dyed material was immersed in a bath containing 3 per cent copper sulphate for 30 minutes. Then it was rinsed and dried.

DYEING WITH THE TUBA DRIED EXTRACT

METHOD 1

The scoured yarn was dyed in a bath containing the tuba dried extract and sufficient water to keep the yarn immersed. This was brought to the boil and worked for ¾ to 1 hour.

It was then hydroextracted, and several after-treatments were applied.

After-treatment (*a*).—The dyed yarn was immersed in a solution containing 3 per cent copper sulphate for 30 minutes. Then it was rinsed and dried.

After-treatment (*b*).—The dyed yarn was immersed in a bath containing 3 per cent copper sulphate, and 3 per cent potassium dichromate for 30 minutes. Then it was soaped, rinsed, and dried.

After-treatment (*c*).—The dyed yarn was immersed in a solution containing 4 per cent lead subacetate for 30 minutes. This was soaped, rinsed, and dried.

After-treatment (*d*).—The dyed yarn was immersed in a solution containing 3 per cent chromium fluoride for 30 minutes. Then it was rinsed and dried.

After-treatment (*e*).—The dyed yarn was immersed in a solution containing 3 per cent potassium dichromate for 30 minutes. Then it was rinsed and dried.

METHOD 2

The second yarn was dyed in a bath containing 30 per cent tuba dried extract, 0.4 per cent sodium hydroxide, 10 per cent common salt (sodium chloride), and sufficient water to keep the yarn immersed. This was brought to the boil and worked in this dye bath for ¾ to 1 hour. Then it was hydroextracted.

The following after-treatments were applied:

After-treatment (*a*).—The dyed yarn was immersed in a bath containing 3 per cent ferric chloride for 30 minutes. Then it was rinsed and dried.

After-treatment (*b*).—The dyed yarn was immersed in a bath containing 3 per cent alum for 30 minutes. Then it was rinsed and dried.

After-treatment (*c*).—The dyed yarn was immersed in a bath containing 3 per cent potassium dichromate for half an hour. Then it was rinsed and dried.

Different shades of tan were obtained from the dried coloring matter and light shades of brown from the concentrate. The

shades, however, depended upon the amount of coloring matter used.

METHOD 3

The scoured yarn was dyed in a bath containing 30 per cent of the dried extract, 3 per cent ferric chloride and sufficient water to cover the yarn. This was brought to the boil gradually and worked for ¾ to 1 hour.

After-treatment.—It was then after-treated in a solution containing 4 per cent potassium dichromate for 30 minutes. Then it was soaped, rinsed, and dried.

FASTNESS PROPERTIES

The dyed materials were tested for their fastness properties. Fair results were obtained from them. Tables 1 and 2 show the fastness properties of these dyed yarns. The fastness is graded according to the following numbers: 1, excellent; 2, very good; 3, good; 4, moderate; 5, poor.

TABLE 1.—*Fastness properties of cotton yarn dyed with tuba concentrate.* (Procedure 1)

[1, Excellent; 2, very good; 3, good; 4, moderate; 5, poor.]

Methods of dyeing	Light	Rubbing	Washing	Lime water	Soda boil	Perspiration	Alkalies: 10 per cent Na_2CO_3.	Alkalies: Ammonia	Acetic acid
Method 1:									
(a) Alum, 3 per cent	3	1	3	3	3	2	3	2	1
(b) Lead subacetate, 4 per cent.	4	1	4	3	4	4	3	3	3
(c) {Copper sulphate, 1 per cent. Potassium dichromate, 1 per cent.}	2	1	3	3	3	3	3	2	3
(d) Ferric chloride, 2 per cent.	3	1	3	3	3	4	3	1	4
(e) Sodium sulphide, 3 per cent.	3	1	3	3	3	3	3	3	3
(f) Chromium fluoride, 3 per cent.	3	1	3	3	3	2	3	1	2
Method 2:									
Copper sulphate, 3 per cent.	3	1	3	3	3	3	3	1	2

TABLE 2.—*Fastness properties of cotton yarn dyed with tuba dried extract.*
(Procedure 2)

[1, Excellent; 2, very good; 3, good; 4, moderate; 5, poor.]

Methods of dyeing	Light	Rubbing	Washing	Lime water	Soda boil	Perspiration	Alkalies: 10 per cent Na_2CO_3.	Alkalies: Ammonia	Acetic acid
Method 1:									
(*a*) Copper sulphate, 3 per cent.	4	1	4	3	3	3	3	3	2
(*b*) { Potassium dichromate, 3 per cent. Copper sulphate, 3 per cent. }	3	1	3	3	3	3	3	1	2
(*c*) Lead subacetate, 4 per cent.	5	2	3	3	3	3	2	3	3
(*d*) Chromium fluoride, 3 per cent.	4	1	3	3	3	3	3	2	2
(*e*) Potassium dichromate, 3 per cent.	5	1	3	3	3	3	3	2	2
Method 2:									
(*a*) Ferric chloride, 3 per cent.	5	1	4	4	4	4	3	4	4
(*b*) Alum, 3 per cent	5	1	3	2	3	3	3	1	2
(*c*) Potassium dichromate, 3 per cent.	5	1	4	4	4	4	3	2	3

SUMMARY

1. The coloring matter of the leaves and stems of *Jatropha curcas* Linn. (tuba) was extracted by boiling with water, one extract evaporated to a syrupy consistency, and the other, to dryness.

2. The extracted matter was applied to cotton yarn by different methods of dyeing and after-treatment.

3. The dyed cotton yarn was tested for its fastness properties.

4. Fair results were obtained from these experiments.

NOTES ON THE INSECT FAUNA OF THE SAMAR GROUP, PHILIPPINES

By F. F. BIBBY
Of Smithville, Mississippi

The material on which the list is based was collected off hours while the writer was stationed as a member of a U. S. Navy malaria and epidemic control unit on Calicoan Island from April to October, 1945.

Besides the writer, J. R. Dodds, L. E. Fronk, J. L. Imhof, Henry Staller, and J. W. Stinson, all of the malaria and epidemic control unit, contributed material and assisted otherwise. Other Navy personnel who contributed material were: H. J. Rayner, J. G. Spann, A. W. Rowbottom, R. C. Hartsfield, and a Mr. Ties.

The identification of the insects, except the Asilidæ, was made by the United States Department of Agriculture, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, Washington, D. C. The identification of the Asilidæ was made by the Bartlett Tree Research Laboratories, Stamford, Connecticut.

The identification of the plants included in the list was made by the United States Department of Agriculture, Agricultural Research Administration, Bureau of Plant Industry, Soils, and Agricultural Engineering, Beltsville, Maryland.

The specimens were taken on Calicoan Island and at nearby places on the adjacent islands of Samar and Leleboon, all between the Pacific Ocean and Leyte Gulf. The elevation varied from seal level to 750 feet above, with some rather abrupt changes.

Some notes on the flora follow:

Wild mallows: *Urena lobata, Sida rhombifolia, Hibiscus tiliaceus, Thespesia populnea, Abutilon* sp.

Other wild plants: *Morus* sp., *Callicarpa* sp., ebony, mahogany, acacia, poinsettia, *Passiflora* sp., cycads, ferns, pandanus, verbena, bamboo, fishtail palm, *Anamirta cocculus* (*lagtang* or fish berry), *Barringtonia asiatica* (fish poison), *Amaranthus* sp., *Polanisia icosandra*, morning-glory (Convolvulaceæ), *Ficus* spp.

Food plants: breadfruit, banana, guava, citrus, coconut, cassava, papaya, taro, sweet potato.

Ornamentals: *Hibiscus rosa-sinensis, Malvaviscus arboreus, Codiaeum variegatum, Abelmoschus moschatus, Bougainvillea, Delonix regia, Datura alba, Lochnera rosea.*

Other cultivated plants: *Derris* sp., cotton (occasional stalk for wicks), tobacco.

In the list of insects to follow, there are represented 13 orders, 100 families, 246 genera, and 310 species.

The number of species to an order, to a family, and to a genus, or the absence of any group, is not necessarily indicative of relative abundance. It could have been affected by facility to collect, by facility to send for determination, or by preference of the collectors.

However, scarcity of species accounts for the absence of the follownig groups from the list:

Carabidæ
Meloidæ
Mutillidæ
Thysanoptera.

ANOPLURA

HAEMATOPINIDÆ

Hoplopleura sp.—Calicoan Island, July 2, 1945, from rat.

COLEOPTERA

ANOBIIDÆ

Lasioderma sp., prob. *serricorne* Fabricius—Calicoan Island, May, 1945.

ANTHRIBIDÆ

Undet. sp.—Calicoan Island, August 27, 1945, from blooms of *Hibiscus tiliaceus.*

BOSTRICHIDÆ

Dinoderus minutus (Fabricius)—Guiuan, Samar, from wooden-soled sandals.

Xylopsocus capucinus (Fabricius)—Calicoan Island, August 29, 1945.

Xylothrips flavipes (Ill.)—Calicoan Island, October 8, 1945, from man who reported it had bitten him.

BUPRESTIDÆ

Agrilus occipitalis Eschscholtz—Calicoan Island, October 15, 1945, from grapefruit foliage.

Chrysodema smaragdula Olivier—Calicoan Island, spring of 1945.

Sambus sp.—Calicoan Island, October 10, 1945, from foliage of shrub along Leyte Gulf. Numerous and lively.

CANTHARIDÆ

Tylocerus atricornis (Guér.)—Calicoan Island, May and June, 1945, from vegetation.

CERAMBYCIDÆ

Aeolesthes induta Newmann—Calicoan Island, spring of 1945.

Apomecyna quadrifasciata Thomson—Calicoan Island, spring and summer of 1945, at light.

Batocera rubus var. *miniszechi* Thomson—Calicoan Island, spring and summer of 1945; one collected August 12 bore *Lophochernes* sp., possibly new (Arachnida, Cheliferidæ).

Cacia vermiculata ab. *dissoluta* Heller—Calicoan Island, June 27, 1945, from jungle vegetation about 500 feet above sea level.

Ceresium sp.—Calicoan Island, September 1, 1945, indoors.

Daphisia leopoldi Fisher—Calicoan Island, spring of 1945.

Dihammus pseudobianor Breun. ?—Calicoan Island, August 27, 1945, from jungle.

Glenea gracilis Aurivillius—Calicoan Island, August 10, 1945, from jungle.

G. maura Pascoe—Calicoan Island, spring of 1945.

G. suavis Newmann—Calicoan Island, May, 1945.

G. versuta ab. *fasciolata* Aurivillius—Calicoan Island, August 10, 1945, from jungle.

G. sp.—Calicoan Island, spring of 1945.

Ichthyodes biguttula Newmann—Calicoan Island, May, 1945.

Lachnopterus auripennis (Newmann)—Calicoan Island, May to July, 1945.

Nyctimene ochraceovittata Aurivillius—Calicoan Island, May, 1945.

Ostedes pauperata Pascoe—Calicoan Island, May, 1945, from jungle.

Pothyne trivittata Newmann—Calicoan Island, June, 1945.

CHRYSOMELIDÆ

Acrocrypta cumingi (Baly)—Calicoan Island, October 18, 1945, from vegetation, 300 feet above sea level.

Aulacophora sp., perhaps a variety of *A. rosae* (Fabricius)—Calicoan Island, May and June, 1945, common on jungle vegetation.

Colasposoma sp., prob. *cumingi* Baly—Calicoan Island, August 5, 1945, from jungle.

C. gregarium LeF.—Calicoan Island, May, 1945.

C. sp.—Calicoan Island, August 5, 1945, from jungle.

Dactylispa sp., new to collection at Washington—Calicoan Island, May, 1945.

Laccoptera luzonica Spaeth—Guiuan, Samar, April, 1945, from *Abelmoschus moschatus.*

Metriona disphorica Spaeth—Calicoan Island, May, 1945, from jungle.

M. trivittata (Fabricius)—Calicoan Island, May, 1945.

Nodosocantha sp., prob. *sexnotata* (Weise)—Calicoan Island, August 10, 1945, from jungle.

Phytorus, 2 spp.—Calicoan Island, May and August, 1945, from jungle.

Platypria sp., new to collection at Washington—Calicoan Island, May, 1945.

Rhyparida sp.—Samar, April, 1945.

Sermyloides sp.—Calicoan Island, May 7, 1945.

Xenoda sp. near *pallida* Jac.—Calicoan Island, April, 1945.

Undet. sp. of genus near *Aulacophora*—Calicoan Island, July 26, 1945, common.

Undet. sp., perhaps *Phytorus* sp., new to collection at Washington—Calicoan Island, October 10, 1945, from foliage of *Thespesia populnea* along Leyte Gulf.

Undet. sp. of genus near *Sphaeroderma*—Calicoan Island, August 10, 1945, from jungle.

Undet. sp. of Galerucinæ, new to collection at Washington—Calicoan Island, August 13, 1945, feeding on foliage of a baylike tree near Leyte Gulf.

CICINDELIDÆ

Cicindela lacrymosa Dej.—Calicoan Island, May, 1945, from sand in the open.

Collyris sp.—Calicoan Island, May, 1945, from jungle vegetation.

Neocollyris sp.—Calicoan Island, August 13, 1945, from jungle vegetation.

Therates labiatus fulvipennis Chd.—Calicoan Island, May to October, 1945, from jungle vegetation; alert but easily captured.

Tricondyla conicicollis Chd.—Calicoan Island, May to July, 1945, from jungle vegetation.

T. punctipennis Chev.—Calicoan Island, May, 1945, from jungle vegetation.

T. sp.—Calicoan Island, May, 1945, from jungle vegetation.

COCCINELLIDÆ

Catana sp., perhaps *clauseni* Chapin—Calicoan Island, October 15, 1945, predator of *Tenaphalara fascipennis* (Crawford) (Psyllidæ) on rubberlike shrub, 250 feet above sea level.

Coelophora 8-punctata (Fabricius)—Calicoan Island, June, 1945, predator of *Aphis medicaginis* Koch on a forage legume (sonting).

C. sp.—Calicoan Island, May, 1945, from jungle vegetation.

Epilachna n. sp.—Calicoan Island, June, 1945, from jungle vegetation.

E. sp.—Calicoan Island, May 7 and August 10, 1945, from jungle vegetation.

Serangium sp.—Calicoan Island, October 15, 1945, in association with *Catana* sp. preying upon *Tenaphalara fascipennis* (Crawford) (Psyllidæ) on a rubberlike shrub (not *Ficus*) 250 feet above sea level.

Undet. sp. of *Scymnus* or related genus—Calicoan Island, August 5, 1945, from underside of leaf of jungle plant of the taro (elephant's-ear) group.

CUCUJIDÆ

Ahasverus advena (Waltl.)—Calicoan Island, June, 1945, at light.

Silvanus bidentatus (Fabricius)—Calicoan Island, June, 1945, numerous and a nuisance, at light.

CURCULIONIDÆ

Alcidodes sp.—Guiuan, Samar, from foliage, October 17, 1945.

Amorphoidea sp., probably same as species treated as *lata* Mots. by Otanes and Butac (1939)—Calicoan Island and Samar, May to October, 1945, larvæ in seed pods of *Hibiscus tiliaceus* and *Thespesia populnea,* and adults numerous in blooms of both hosts.

Apion sp.—Calicoan Island, May, 1945, from foliage of *Urena lobata.*

Homalocyrtus sp.—Calicoan Island, May 10, 1945, from foliage of *Hibiscus tiliaceus.*

Metapocyrtus sp.—Calicoan Island, October 18, 1945, on foliage 200 feet above sea level.

Pachyrhynchus sp.—Samar, May, 1945.

Peribleptus dealbatus (Boisduval)—Calicoan Island, June, 1945, from jungle vegetation.

Pyrgops sp.—Samar, September 8, 1945, from foliage of *Urena lobata,* and Calicoan Island, September 26, from foliage of *Hibiscus tiliaceus.*

Rhynchites plagiocephalus Voss—Calicoan Island, October 15, 1945, from foliage.

Rhynchophorus ferrugineus (Olivier) or *pascha* Boh.—Calicoan Island, August 20, 1945.

Undet. sp. of Celeuthetini—Calicoan Island, May 7, 1945, from foliage of *Hibiscus tiliaceus* and from foliage of pepper.

DYTISCIDÆ

Hydaticus fabricii (McLeay)—Calicoan Island, May 14, 1945, from standing water in swamp.

ELATERIDÆ

Agrypnus bifoveatus Candèze—Calicoan Island, June, 1945, at light.

Neodiploconus sp.—Calicoan Island, May 7, 1945.

EROTYLIDÆ

Hybosoma hydropicum Gorh.—Calicoan Island, June 27, 1945, from jungle, 500 feet above sea level.

Rhopalotritoma amabilis Heller—Calicoan Island, from jungle, 300 feet above sea level.

LAMPYRIDÆ

Luciola sp.—Calicoan Island, May 8, 1945.

LANGURIIDÆ

Anadastus sp.—Calicoan Island, June, 1945.

LYCIDÆ

Lyropaeus sp.—Calicoan Island, October 18, 1945, from vegetation, 300 feet above sea level.

Metriorhynchus sp.—Calicoan Island, May, 1945.

Undet. sp., genus not recognized—Calicoan Island, August 19, 1945, from jungle vegetation.

MORDELLIDÆ

Glipa sp.—Calicoan Island, May and June, 1945, on jungle vegetation, common but evasive.

NITIDULIDÆ

Carpophilus dimidiatus (Fabricius)—Calicoan Island, July 2, 1945, combed from rat trapped in commissary.

Haptoncus sp. near *luteolus* Er.—Calicoan Island, September 9, 1945, from blooms, flower buds, and seed pods of *Hibiscus tiliaceus;* and Samar, September 10, from same kind of material.

Undet. sp., not in U. S. National Museum—Calicoan Island, September 6, 1945, from fresh and wilted blooms of *Thespesia populnea;* and Samar, September 8, from blooms of *Hibiscus tiliaceus.*

PLATYPODIDÆ

Platypus sp., near *lepidus* Chap.—Calicoan Island, August 29, 1945, indoors.

SCARABAEIDÆ

Anomala (*Euchlora*) *chloropyga* Burmeister—Calicoan Island, May and June, 1945, from jungle vegetation, 300 feet above sea level.

A. sp.—Calicoan Island, October 15, 1945, from jungle vegetation.

Dasyvalgus panaonus Mos.—Calicoan Island, October 18, 1945, from jungle vegetation, 300 feet above sea level.

Microserica sp.—Samar, October 17, 1945, from foliage.

Onthophagus sp.—Calicoan Island, June, 1945.

Oryctes rhinoceros (Linnæus)—Samar, May, 1945.

Philaelota sulana Heller—Calicoan Island, August 15, 1945, indoors.

Pseudomalaia semperi Kraatz—Guiuan, Samar, April, 1945, from blooms of *Abelmoschus moschatus.*

SCOLYTIDÆ

Xyleborus sp., prob. *parvulus* Eichhoff—Calicoan Island, June, 1945, indoors at light.

X. sp., prob. *perforans* (Woll.)—Calicoan Island, June, 1945, indoors at light; and July 4, 1945, combed from a trapped rat.

X. sp.—Calicoan Island, May, 1945, reported to have bitten a person.

TENEBRIONIDÆ

Ceropria sp.—Calicoan Island, October 10, 1945, indoors.

Strongylium sp.—Calicoan Island, October 18, 1945, from vegetation, 300 feet above sea level.

Undet. sp. of *Bradymerus* or related genus—Calicoan Island, August 7, 1945, from water in axil of banana leaf.

COLLEMBOLA

ISOTOMIDÆ

Isotomurus sp.—Calicoan Island, July, 1945, from water puddle accumulated from recent rain.

CORRODENTIA

PSOCIDÆ

Ectopsocus sp.—Calicoan Island, July, 1945, from pasteboard box containing dry buds of *Hibiscus tiliaceus.*

TROGIIDÆ

Liposcelis sp.—Calicoan Island, June, 1945, devouring museum specimens of mosquitoes.

DIPTERA

AGROMYZIDÆ

Desmometopa sp.—Calicoan Island, July 25, 1945, in association with *Hecamede* sp., prob. *persimilis* Hendel, and *Gymnopa* sp. (Ephydridæ).

Milichiella sp.—Calicoan Island, September 7, 1945, from tip of twigs of *Thespesia populnea.*

Tethina sp.—Calicoan Island, July 23, 1945, in association with *Hebecnema* sp. (Ephydridæ) on seaweed along shore of the Pacific Ocean; and September 12, indoors.

ASILIDÆ

Dalmalina semperi O. S.—Calicoan Island, August 10, 1945, from fermenting banana plant.

D. sp.—Calicoan Island, May and June, 1945.

Maira sp.—Calicoan Island, June and August, 1945.

Ommatius chinensis Fabricius—Calicoan Island, June 7, 1945.

O. sp.—Calicoan Island, June 7, 1945.

Philodicus longipes Schiner—Calicoan Island, June, 1945, one with prey, small butterfly (Lycaenidæ); and Leleboon Island, June 22, 1945.

Promachus bifasciatus Macquart—Leleboon Island, June 22, 1945.

P. manilliensis Macquart—Calicoan Island, May, 1945.

P. philippinus Ricardo—Calicoan Island, May, 1945.

P. varipes Macquart—Calicoan Island, May, 1945.

P. sp.—Calicoan Island, August 11, 1945.

BOMBYLIIDÆ

Undet. sp., prob. of genus *Hyperalonia*—Leleboon Island, June 26, 1945.

CALLIPHORIDÆ

Chrysomya megacephala (Fabricius)—Calicoan Island, May, 1945; and Leleboon Island, June 25, 1945.

Hemipyrellia tagaliana (Bigot)—Calicoan Island, May 15, 1945.

CHLOROPIDÆ

Eutropha n. sp., near *noctilus* (Walker)—Calicoan Island, July 29, 1945, in association with *Allotrichoma alium* Cresson, *Gymnopa* sp. and *Hecamede* sp. (Ephydridæ).

Formosina sp.—Calicoan Island: June 29, 1945, numerous on taro and other vegetation growing in sand in the open along the Pacific Ocean; and July 23, in association with *Aphis medicaginis* Koch, on leguminous plant by the sea.

Prohippelates pallidus (Loew.)—Calicoan Island, June, 1945, in association with *Hecamede albicans* (Meigen) (Ephydridæ).

Undet. sp.—Calicoan Island, August 26, 1945, swept from morning-glory (Convolvulaceæ).

COELOPIDÆ

Coelopa sp.—Calicoan Island, September 6, 1945, from tender foliage of *Thespesia populnea.*

DOLICHOPODIDÆ

Sciapus sp.—Calicoan Island, May, 1945.

DROSOPHILIDÆ

Drosophila, 2 spp., one prob. *melanogaster* Meigen—Calicoan Island, August 10, 1945, from fermenting banana plant.

EMPIDÆ

Drapetis, 2 spp.—Calicoan Island, August 25, 1945, swept from morning-glory (Convolvulaceæ).

EPHYDRIDÆ

Allotrichoma alium Cresson—Calicoan Island, July 29, 1945, in association with *Eutropha* n. sp., near *noctilus* (Walker) (Chloropidæ), and *Gymnopa* sp. and *Hecamede* sp. (Ephydridæ).

Gymnopa sp.—Calicoan Island, July 25, 1945, in association with *Desmometopa* sp. (Ayromyzidæ) and *Hecamede* sp., prob. *persimilis* Hendel (Ephydridæ) from dead land crab on sand; and July 25, from bare sand.

Hebecnema sp.—Calicoan Island, July 23, 1945, in association with *Tethina* sp. (Agromyzidæ) on seaweed along shore of the Pacific Ocean.

Hecamede albicans (Meigen)—Calicoan Island, June, 1945, in association with *Prohippelates pallidus* (Loew.) (Chloropidæ).

H. sp.—Calicoan Island, July 25, 1945, in association with *Desemometopa* sp. (Agromyzidæ) and *Gymnopa* sp. (Ephydridæ) on dead land crab; and July 30 from bare sand.

FUNGIVORIDÆ

Lycoria sp.—Calicoan Island, July 4, 1945, combed from a trapped rat.

LUXANIIDÆ

Homoneura ochripennis (Frey)—Calicoan Island, October 14, 1945, from foliage of lemon seedling in bloom. The flies were easily captured without net.

H. padangensis (de Meijere)—As above.

MUSCIDÆ

Dichaetomyia quadrata (Wd.)—Calicoan Island, August 10, 1945, from fermenting banana plant.

Musca sorbens Wd.—Calicoan Island, May, 1945.

M. vetustissima Walker—Calicoan Island, October 6, 1945, indoors.

Ophyra chalcogaster (Wied.)—Samar, October 7, 1945, from citrus foliage.

Siphona exigus (de Meijere)—Leleboon Island, June 25, 1945, from cow.

Stomoxys calcitrans Linnæus—As above.

Telostylus sp., prob. *decemnotatus* Hendel—Calicoan Island, August 10, 1945, from fermenting banana plant.

OTITIDÆ

Elassogaster metallicus Bigot—Calicoan Island, June, 1945, from vegetation.

Naupoda platessa Osten Sacken—Calicoan Island, October 15, 1945, from bird excrement on jungle foliage.

Scelostenoplerina sp.—Calicoan Island, May, 1945.

PHORIDÆ

Megaselia sp., prob. *scalaris* (Loew.)—Calicoan Island, spring of 1945.

PIOPHILIDÆ

Piophila latipes Meigen—Samar, October 7, 1945, from citrus foliage.

SARCOPHAGIDÆ

Sarcophaga albiceps Meigen—Calicoan Island, June 27, 1945, from jungle, 500 feet above sea level.

S. antilope Bott.—Calicoan Island, May, 1945.

S. knabi Parker—Calicoan Island, August 9, 1945, from *Urena lobata.*

S. misera Walker—Calicoan Island, May and June, 1945.

S. orchidea Bott.—Calicoan Island, May and August, 1945.

S. orientalis Park.—Calicoan Island, June, 1945.

S. orientaloides S. W.—Calicoan Island, May, 1945.

S. sp.—Samar, October 7, 1945, from citrus foliage.

STRATIOMYIDÆ

Merosargus sp.—Calicoan Island, August 10, 1945, from fermenting banana plant.

Negritomyia consobrina (Bigot)—Calicoan Island, October 15, 1945.

Ptilocera smaragdina Walker—Calicoan Island, June, 1945.

Rosapha habilis Walker—Calicoan Island, October 8, 1945, from foliage of *Barringtonia asiatica* along Leyte Gulf.

SYRPHIDÆ

Baccha sp.—Calicoan Island, May to August, 1945.

Tubifera sp.—Calicoan Island: June, 1945; and October 8, 1945, from *Hibiscus tiliaceus.*

Volucella sp.—Samar, May 6, 1945, associated with the psyllid *Mesohomotoma hibisci* (Froggatt) on *Hibiscus tiliaceus;* and Calicoan Island, September 26, from *H. tiliaceus.*

TABANIDÆ

Tabanus sp., near *effilatus* S. S.—Calicoan Island, July 23, 1945, indoors.

TENDIPEDIDÆ

Tendipes sp.—Calicoan Island: June, 1945, numerous on leaves of banana; August 29, at light.

TEPHRITIDÆ

Acidoxantha sp.—Calicoan Island, September 25, 1945, reared from a maggot found feeding in flower bud of *Hibiscus tiliaceus* (September 8). Two other adults of the same species reared from maggots found in buds of the same plant on the same day (September 8) emerged September 27 and 30. From another maggot of the same material, the hymenopterous parasite *Opius longicaudatus* (Ashmead) emerged instead of the fly. Maggots of *Acidoxantha* sp. were found in the flower buds of *Hibiscus tiliaceus* from Samar, also, September 10, but no adults reared.

TYLIDÆ

Grallopoda galbula (Osten Sacken)—Guiuan, Samar, April, 1945, from *Hibiscus tiliaceus* infested with the psyllid *Mesohomotoma hibisci* (Froggatt) and from *Abelmoschus moschatus;* and Calicoan Island, June, 1945, from other vegetation.

G. morbida (Osten Sacken)—Guiuan, Samar, April, 1945, from *Abelmoschus moschatus;* and Calicoan Island, June, 1945, from other vegetation.

HEMIPTERA

ANTHOCORIDÆ

Cardiastethus sp., near *rugicollis* Champ.—Calicoan Island, June, 1945, from pasteboard box containing dry buds of *Hibiscus tiliaceus.*

BELOSTOMATIDÆ

Sphaerodema rusticum (Fabricius)—Calicoan Island, May 21, 1945, dead specimen, from swamp.

COREIDÆ

Cletus sp.—Calicoan Island, May 24, 1945.

Homoeocerus bipustulatus Stål—Calicoan Island, May, 1945.

Leptocorisa acuta (Thunberg)—Calicoan Island, May, 1945.

Physomerus oedimerus (Burmeister)—Calicoan Island, May to September, 1945, from foliage of *Hibiscus tiliaceus* and from other vegetation. Eggs were laid in clusters of 50 to 75 on upper sides of foliage of shrubs and trees of various species. An adult was usually perched on the eggs. A leaf bearing a cluster of 70 eggs and an adult female perched on the eggs was taken indoors for observation. The adult (without being caged) remained constantly on the eggs for six days (August 27 to September 1) and would have probably remained there until the eggs hatched, if she had not been severely disturbed by transfer of the material. The eggs hatched nine days after having been abandoned by the adult (September 10), indicating an incubation period of 15 days or longer.

Riptortus linearis (Fabricius)—Calicoan Island, May, 1945.

R. pedestris Stål—Calicoan Island, June, 1945.

GERRIDÆ

Limnogonus sp.—Samar, April, 1945.

HYDROMETRIDÆ

Hydrometra lineata Eschscholtz—Calicoan Island, June, 1945, from brackish water.

LYGAEIDÆ

Astacops nigripes Stål—Calicoan Island, October 18, 1945, numerous on tree trunk, 400 feet above sea level.

A. sp.—Leleboon Island, June 25, 1945, from foliage.

Dasynus coccocinctus Burmeister—Leleboon Island, June 25, 1945, rare.

Dieuches uniguttatus (Thunberg)—Calicoan Island, August 10, 1945, from jungle vegetation.

Geocoris flaviceps (Burmeister)—Calicoan Island, May and July, 1945.

MIRIDÆ

Hyalopeplus vitripennis Stål—Calicoan Island, June, 1945, from foliage.

Pachypeltis ståli Distant—As above.

PENTATOMIDÆ

Antestia cruciata (Fabricius)—Calicoan Island, October 10, 1945, from foliage of a shrub along seashore of Leyte Gulf.

Chrysocoris germari var. *consul* (Vollenhoven)—Calicoan Island, May 13, 1945, from jungle vegetation.

Cuspicona sp.—Calicoan Island, June 7, 1945.

Cyclopelta obscura (Lepelletier & Serville)—Calicoan Island, August, 1945.

Eysarcoris bovillus Dallas—Calicoan Island, May and June, 1945.

E. guttigerus Thunberg—As above.

E. sp.—Calicoan Island, May and August, 1945, from jungle vegetation.

Undet. sp. of tribe Acanthosomini, probably a new genus near *Cyphostethus* Fieber—Calicoan Island, October 15, 1945, from shrub bearing berries, 350 feet above sea level, only one other specimen was seen. It was from a plant of the same species.

PLATASPIDÆ

Coptosoma cincta (Eschscholtz)—Leleboon Island, May, 1945, from legume (sonting).

PYRRHOCORIDÆ

Dysdercus crucifer Stål—Calicoan Island, May to October, 1945, feeding on flower buds, seed pods, and foliage of *Hibiscus tiliaceus,* apparently its preferred host.

D. megalopygus Breddin—Calicoan Island, Leleboon Island, and Samar, April to October, 1945, from *Urena lobata, Sida* spp., and *Abelmoschus moschatus.*

D. poecilus (Herrich-Schäffer)—Same localities, dates, and hosts as, and usually in association with, *D. megalopygus.*

REDUVIIDÆ

Endochus histrionicus Stål—Calicoan Island, May, 1945.

Euagoras tagalicus Stål—Leleboon Island, June 23, 1945, eggs, nymphs, and adults, on shrub along seashore.

E. sp.—Calicoan Island, May, 1945.

Rihirbus trochantericus Stål—Calicoan Island, May, 1945.

Stachyomerus pallescens Stål—Calicoan Island, August 10, 1945, from jungle.

Sphodronyttus erythropterus (Burmeister)—Calicoan Island, May, 1945.

S. semirufus Stål—Calicoan Island, June 27, 1945, 500 feet above sea level.

Sycanus ståli Dohrn.—Calicoan Island, May and June, 1945.

Veledella sp.—Calicoan Island, May, 1945.

Vesbius purpureus Thunberg—Calicoan Island, July 30, 1945, indoors.

Undet. sp., apparently of a new genus close to *Epidaus*—Calicoan Island, May, 1945.

HOMOPTERA

APHIDÆ

Aphis citricidus (Kirkaldy)—Samar and Calicoan Island, April and May, 1945, from citrus foliage.

A. fabæ Scopoli—Calicoan Island, May, 1945, probably from an herbaceous legume (sonting).

A. laburni Kaltenbach—Calicoan Island, June and July, 1945, from two species of legume, sonting and another.

CERCOPIDÆ

Phymatostetha montana Schmidt—Calicoan Island, June, 1945.

CICADELLIDÆ

Bothrogenia sp. near *ferruginea* (Fabricius)—Calicoan Island, May 7, 1945.

Cicadella sp.—Calicoan Island, May, 1945.

Tartessus malayus Stål—Calicoan Island, May, 1945.

CICADIDÆ

Cosmopsaltria inermis Stål—Samar, spring of 1945.

COCCIDÆ

Lepidosaphes belonging to the *tubulorum*-complex—Calicoan Island, June 27, 1945, on leaves of a jungle tree 400 feet above sea level.

Pinnaspis sp.—Leleboon Island, June 25, 1945, on foliage of shrub along seashore.

Pseudococcus lilacinus (Cockerell) ?—Calicoan Island, October 14, 1945, from tree in brackish swamp adjacent to Leyte Gulf.

P. (*Ferrisia*) *virgatus* (Cockerell)—Leleboon Island, June 25, 1945, on guava foliage and twigs; and Samar, spring, 1945, on citrus and *Codiaeum variegatum.*

Saissetia hemisphaerica (Targiori-Tozetti)—Calicoan Island, May 15, 1945, on underside of leaves of a jungle shrub.

DELPHACIDÆ

Delphacodes sp.—Calicoan Island, August 25, 1945, at light.

Liburnia furcifera Horvåth—As above.

FLATIDÆ

Mesophylla alba Jac.—Calicoan Island, May 24, 1945.

FULGORIDÆ

Dictyophara, 2 spp., one prob. *nakanonis* Matsumura—Calicoan Island and Samar, May to September, 1945.

Epora subtilis Walker—Calicoan Island, May, 1945.

Mindura sp.—Calicoan Island, October 14, 1945, from vegetation in dense jungle.

Neomelicharia calichroma (Walker)—Leleboon Island, June 29, 1945, numerous on breadfruit.

Virgilia sp., prob. new—Calicoan Island, May, 1945.

MEMBRACIDÆ

Gargara nigrocarinata Funkhouser—Samar, August 29, 1945, from foliage of *Hibiscus tiliaceus.*

G. nitidipennis Funkhouser—As above.

G. varicolor Stål—Calicoan Island, May to October, 1945.

Tricentrus pilinervosus Funkhouser—Samar, April, 1945, from *Abelmoschus moschatus.*

PSYLLIDÆ

Mesohomotoma hibisci (Froggatt)—Guiuan, Samar, April, 1945, from *Hibiscus tiliaceus.*

Tenaphalara fascipennis (Crawford)—Calicoan Island, October 15, 1945, from leaves of a rubberlike plant.

HYMENOPTERA

ANTHOPHORIDÆ

Anthophora sp.—Calicoan Island, September 11, 1945, from foliage in swamp.

APIDÆ

Apis dorsata Fabricius, the so-called giant or wild honeybee, "wild" referring to the fact it cannot be domesticated—Calicoan Island, May 8, 1945, at light.

A. florea Fabricius—Calicoan Island, August 10, 1945, found dead on jungle foliage.

Thyreus sp.—Calicoan Island, June, 1945.

BRACONIDÆ

Campyloneurus sp.—Calicoan Island, May, 1945.

Iphaulax sp.—As above.

Microbracon sp., apparently new—Calicoan Island, June, 1945.

Opius longicaudatus (Ashmead)—Calicoan Island, September 27, 1945, emerged from puparium of *Acidoxantha* sp.; period of development 20 days or longer (notes under *Acidoxantha* sp., Diptera, Tephritidæ).

Spathius sp.—Calicoan Island, May, 1945.

ENCYRTIDÆ

Psyllæphagus sp.—Guiuan, Samar, April, 1945, from *Hibiscus tiliaceus* infested with *Mesohomotoma hibisci* (Froggatt) (Psyllidæ).

FORMICIDÆ

Anoplolepis longipes (Jerdon)—Calicoan Island: June, 1945, attending *Aphis laburni* Kaltenbach on legume; June 25, 1945, a nuisance in kitchen; and September 7, on tips of twigs of *Thespesia populnea.*

Camponotus (*Colobopsis*) sp.—Calicoan Island: May 8, 1945, at light; May 13, from foliage of *Hibiscus tiliaceus;* August 29 and September 5, at light; September 7 from tips of twigs of *Thespesia populnea;* October 14, from shrub along seashore of Leyte Gulf. And Samar, September 3, 1945, attending a species of mealybug (*Pseudococcus*) on fruit of *Ficus* sp.

Crematogaster sp.—Calicoan Island: May 10, 1945, from foliage of *Hibiscus tiliaceus;* and May 15, attending *Saissetia hemisphærica* (Targioni-Tozetti) on underside of leaves of a jungle shrub.

Diacamma sp.—Calicoan Island, June, 1945, one carrying a mutilated homopteron.

Dolichoderus (*Hypoclinea*) *bituberculatus* (Mayr.)—Samar, August 29, 1945 and Calicoan Island, September 9, from foliage of *Hibiscus tiliaceus*.

Monomorium (*Lampromyrmex*) sp.—Calicoan Island, May 8, 1945.

Odontoponera transversa (F. Smith)—Calicoan Island, September 9, 1945, from sand in the open.

Oecophylla smaragdina (Fabricius)—Calicoan Island, August 5, 1945, from jungle vegetation.

Paratrechina longicornis (Latreille)—Calicoan Island: September 9, 1945, from sand in the open; and October 15, 1945, from flower buds of a shrub along seashore of Leyte Gulf.

Polyrhachis cyaniventris (F. Smith)—Calicoan Island, May and June, 1945.

P. ypsilon Emery—As above.

Solenopsis geminata rufa (Jerdon)—Calicoan Island: August 15 and 23, 1945, as household pest at different places on the island; and September 9, from foliage of *Hibiscus tiliaceus* and from sand in the open.

ICHNEUMONIDÆ

Theronia sp.—Calicoan Island, August 19, 1945, from fermenting banana plant in jungle.

MEGACHILIDÆ

Megachile sp.—Calicoan Island, August 12, 1945.

MELIPONIDÆ

Trigona sp.—Calicoan Island, May, July, and August, 1945.

PSAMMOCHARIDÆ

Batazonus orientalis (Cameron)—Guiuan, Samar, September 8, 1945, from foliage of *Urena lobata*.

SCOLIIDÆ

Campsomeris aureicollis (Lepeletier)—Calicoan Island, August 9, 1945, outdoors; and August 27, indoors.

C. sp.—Calicoan Island, May, 1945.

SPHECIDÆ

Argogorytes sp.—Calicoan Island, August 24, 1945, indoors.

Chlorion aurulentus sericeus (Fabricius)—Calicoan Island, October 9, 1945, indoors.

C. hæmorrhoidalis muticus (Kohl)—Calicoan Island, August 29, 1945.

C. hæmorrhoidalis siamensis (Taschenberg)—Calicoan Island, May, 1945.

C. luteipennis (Mocsary)—Calicoan Island, September 9, 1945, from sand in the open.

C. umbrosa plumifera (Costa)—Calicoan Island, September 11, 1945, from foliage in swamp.

Lyroda venusta Bingham—Calicoan Island, August 24, 1945, swept from morning-glory (Convolvulaceæ).

STEPHANIDÆ

Stephanus sp.—Calicoan Island, May, 1945.

VESPIDÆ

Polistes dubius de Saussure—Calicoan Island, May, 1945.

Rygchium atrum de Saussure—Calicoan Island and Samar, September, 1945.

XYLOCOPIDÆ

Xylocopa sp.—Calicoan Island, May and June, 1945.

ISOPTERA

TERMITIDÆ

Nasutitermes (*N.*) *panayensis* Oshima—Calicoan Island, June, 1945, indoors.

ODONATA

LIBELLULIDÆ

Erythrodiplax sp.—Calicoan Island, May, 1945, from jungle swamp.

Sympetrum sp.—As above.

ORTHOPTERA

BLATTIDÆ

Blattella germanica (Linnæus)—Calicoan Island, April to October, 1945, household pest.

Epilampra sp.—Calicoan Island, June, 1945, indoors.

Panesthia sp.—As above.

Symploce sp.—Calicoan Island, October 18, 1945, from jungle, 400 feet above sea level.

Undet. sp. of Pseudomopinæ—Calicoan Island, June, 1945, from *Hibiscus tiliaceus* in swamp and September 10, from other vegetation.

PHASMATIDÆ

Sipyloidea, 2 spp.—Calicoan Island and Leleboon Island, June, 1945, from jungle vegetation.

LOCUSTIDÆ

Catantops infuscatus (De Haan)—Calicoan Island, May, 1945.
Oxya sp.—Calicoan Island, August, 1945.

MANTIDÆ

Hierodula patellifera (Serville)—Calicoan Island, May, 1945.
Leptomantis sp.—As above.

TETTIGONIIDÆ

Anerota sp.—Calicoan Island, July 26 and August 25, 1945.

LEPIDOPTERA

AMATIDÆ

Amata (?) sp.—Calicoan Island, summer of 1945.
Callitomis sp.—As above.

COSMOPTERYGIDÆ

Pyroderces, prob. n. sp.—Calicoan Island, June, 1945, reared from dry seed pods of *Hibiscus tiliaceus.*

GELECHIIDÆ

Pectinophora gossypiella (Saunders)—Calicoan Island, September 17, 1945, larvæ from flower buds of *Thespesia populnea.*

GLYPHIPTERYGIDÆ

Tortyra sp.—Calicoan Island, June 26, 1945.

NYMPHALIDÆ

Hypolimnas antilope (Cramer)—Calicoan Island, June, 1945, reared from caterpillars on *Morus* sp. in jungle.

PHALAENIDÆ

Undet. sp.—Calicoan Island, September 9, 1945, immature larva feeding in young seed pod of *Hibiscus tiliaceus.*

PHYCITIDÆ

Undet. sp.—Calicoan Island, October 8, 1945, caterpillars within web defoliating *Barringtonia asiatica* along Leyte Gulf.

PYRALIDÆ

Diaphanea sp.—Calicoan Island, May, 1945, at light.

PYRAUSTIDÆ

Dichocrocis surusalis (Walker)—Calicoan Island, June 21, 1945, emerged from caged flower buds and seed pods of *Hibiscus tiliaceus;* September 8 to 12, many larvæ of this species or some other of the family were taken feeding in flower buds, blooms and young seed pods of the same host (*H. tiliaceus*), but no adults reared.

XYLORCTIDÆ

Undet. sp.—Calicoan Island, Samar of 1945, larvæ feeding in flower buds and seed pods of *Hibiscus tiliaceus.*

SIPHONAPTERA

PULICIDÆ

Ctenocephalides felis (Bouche)—Calicoan Island, July 23, 1945, from dog.

Pulex irritans Linnæus—Calicoan Island: June 25, 1945, from man; and October 10, from dog.

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ARTIFICIAL FERTILIZATION AND EMBRYOLOGY OF MIROGOBIUS LACUSTRIS HERRE

By GUILLERMO J. BLANCO
Of the Division of Fisheries
Department of Agriculture and Commerce, Manila

TWO PLATES

This paper presents notes on the artificial fertilization and the early development of *Mirogobius lacustris* Herre, a small transparent goby of the family Gobiidæ. Roxas and Blanco (1937) made a revision of the genus *Mirogobius* Herre (Gobiidæ) based on the constant vertebral and the greater fin ray counts of the two known species *M. lacustris* and *M. stellatus*. *M. lacustris* is known as *dolong* in Tagalog, and *kip-kip* in Iloko. It is found in Lanigay, Polangui, Albay Province; Laguna de Bay, Laguna Province; and Paoay Creek, Paoay and Butong Lake, Laoag, Ilocos Norte Province. It is a source of goby fry used for food.

Artificial fertilization.—The artificial fertilization of the kip-kip was undertaken in August, 1939, as a contribution to the early life histories of Philippine fresh-water fishes. Sexually mature females of *M. lacustris* are easily recognized by the presence of ripe, intermediate, and immature eggs in their transparent bodies. Males of the species are larger than the females; their heads are larger and bulldoglike, and the genital organs, decidedly larger.

The following procedure was followed in artificial fertilization: A ripe female was removed from an aquarium with a small dipnet; its abdomen was pressed gently towards its genital opening with the thumb and forefinger. As a result of the pressure eggs sprung from the oviduct one at a time. The eggs extruded were placed in a clean watch glass with a fine pincer. Each egg is provided with long adhesive threads that radiate from the apical poles. The eggs were attached to one another by means of these adhesive threads, to form clusters. Adhesive threads or filaments of eggs are morphological characteristics of cyprinids, atherinids, and phallostethids. The filaments or threads protect the eggs during embryonic development by

keeping them intact and protecting them from being drifted by currents and other physical agencies. Hence, egg filaments are necessary for pelagic eggs that require a longer time for development.

A dissection of a ripe female was made to ascertain the type of eggs in the ovary. The immature eggs (Plate 1, fig. 1) are oblong and nucleated. The intermediate eggs are more or less globular with a quantity of yolk material (Plate 1, fig. 2). A mature egg, which is about 1 mm in diameter (Plate 1, fig. 3), carries a much greater amount of yolk material and its perivitelline space is narrower in the yolk-sphere.

A sexually mature male was also removed from the aquarium, and its abdomen also gently pressed towards its genital opening. The pressing was done in such a way that the milt dropped on the eggs which were placed in the watch glass half filled with water from the aquarium. The artificially fertilized eggs were later transferred to two watch glasses containing tap water which was changed daily. The incubation period of the eggs under laboratory conditions lasted from three to four days.

Embryology of M. lacustris.—An observation of the embryological development of the fertilized egg was made with the aid of a compound miscroscope, and all drawings of the living materials were made with the aid of a camera lucida.

About thirty minutes after fertilization the egg shell changes its globular shape into a pear-shaped appearance (Plate 1, fig. 4). First cleavage is very apparent in the yolk sphere by the presence of a blastodisc protoplasm of about equal the size of the yolk of the egg.

One hour after fertilization the blastodisc divides into equal daughter cells (Plate 1, fig. 5). About one and a half hours after fertilization the second plane of cleavage appears cutting the first plane at right angles (Plate 1, fig. 6). The blastodisc of eight cells has a bilateral symmetry two and a half hours after fertilization (Plate 1, fig. 7). The multiplication of the cells after this stage is very irregular until the mass of protoplasm of the blastodisc covers one-half of the yolk sphere (Plate 1, figs. 8–9). Twenty hours after fertilization the germ ring is developed (Plate 1, figs. 10–11). A group of cells are pushed in towards the cleavage cavity thus forming the embryonic shield (Plate 1, fig. 12). As the blastoderm increases rapidly in size and the germ ring advances around the yolk, the embryonic shield has grown larger and more de-

finitely outlined as a linear thickening on the anteroposterior axis of the former embryonic shield (Plate 2, fig. 1). The later embryonic stages are very much noticeable when the embryo increases in size and the yolk sphere diminishes in size. An embryo coiled around more than half of the yolk sphere (Plate 2, fig. 2) has the beginning of the eyes thirty hours after fertilization. The optic vesicles and eight somites are developed thirty-six hours after fertilization (Plate 2, figs. 3–4). Embryonic circulation is in evidence forty-eight hours after fertilization (Plate 2, fig. 5). The embryo has developed fin folds and the yolk is very much reduced in size sixty-four hours after fertilization (Plate 2, fig. 6). The embryo is very active within the egg shell and changes its position every other minute. Plate 2, fig. 7, is an illustration of embryo in the shell seventy-eight hours after fertilization. Viewed dorsally eighty hours after fertilization, the embryo shows well-developed head, eyes, ear bones, reduced yolk sac, and traces of larval intestines and myotomes (Plate 2, fig. 8). The newly hatched larva (Plate 2, fig. 9), eighty-four hours after fertilization, has a well-developed notochord which does not extend to the axial lobe of the caudal fin; the dorsal fin fold is as narrow as that of the ventral fin; the myotomes are well developed. Traces of the larval intestine which runs parallel the notochord and behind the reduced yolk sac are apparent. The head has well-developed eyes and ear bones.

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ILLUSTRATIONS

[Camera lucida drawings by the author.]

PLATE 1. MIROGOBIUS LACUSTRIS HERRE

FIG. 1. Immature egg; × 100.
2. Intermediate egg; × 100.
3. Mature egg, top view; × 100.
4. Egg, one-cell stage; × 100.
5. Egg, two-cell stage; × 100.
6. Egg, four-cell stage; × 100.
7. Egg, eight-cell stage; × 100.
FIGS. 8–9. Eggs showing multiplication of cells; × 100.
10–11. Eggs showing germ ring and blastula stages; × 100.
FIG. 12. Egg showing embryonic shield; × 100.

PLATE 2. MIROGOBIUS LACUSTRIS HERRE

FIG. 1. Egg showing primitive streak; × 100.
2. Egg showing developing embryo; × 100.
FIGS. 3–4. Embryo, 36 hours after fertilization; × 100.
FIG. 5. Embryo, 48 hours after fertilization; × 100.
6. Embryo, 64 hours after fertilization; × 100.
7. Embryo, 78 hours after fertilization; × 100.
8. Embryo, 80 hours after fertilization; × 100.
9. Larva, 84 hours after fertilization; × 100.

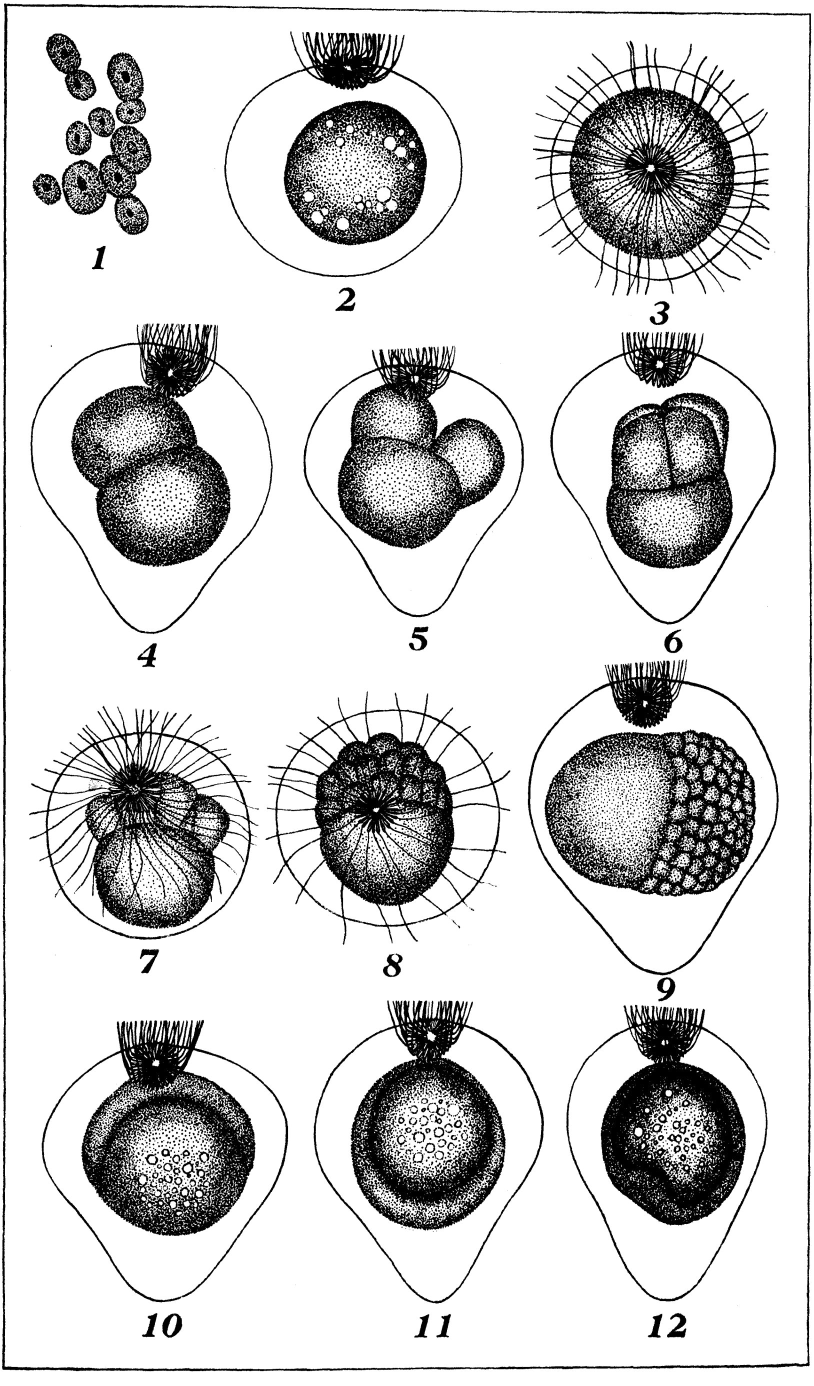

PLATE 1. MIROGOBIUS LACUSTRIS HERRE.

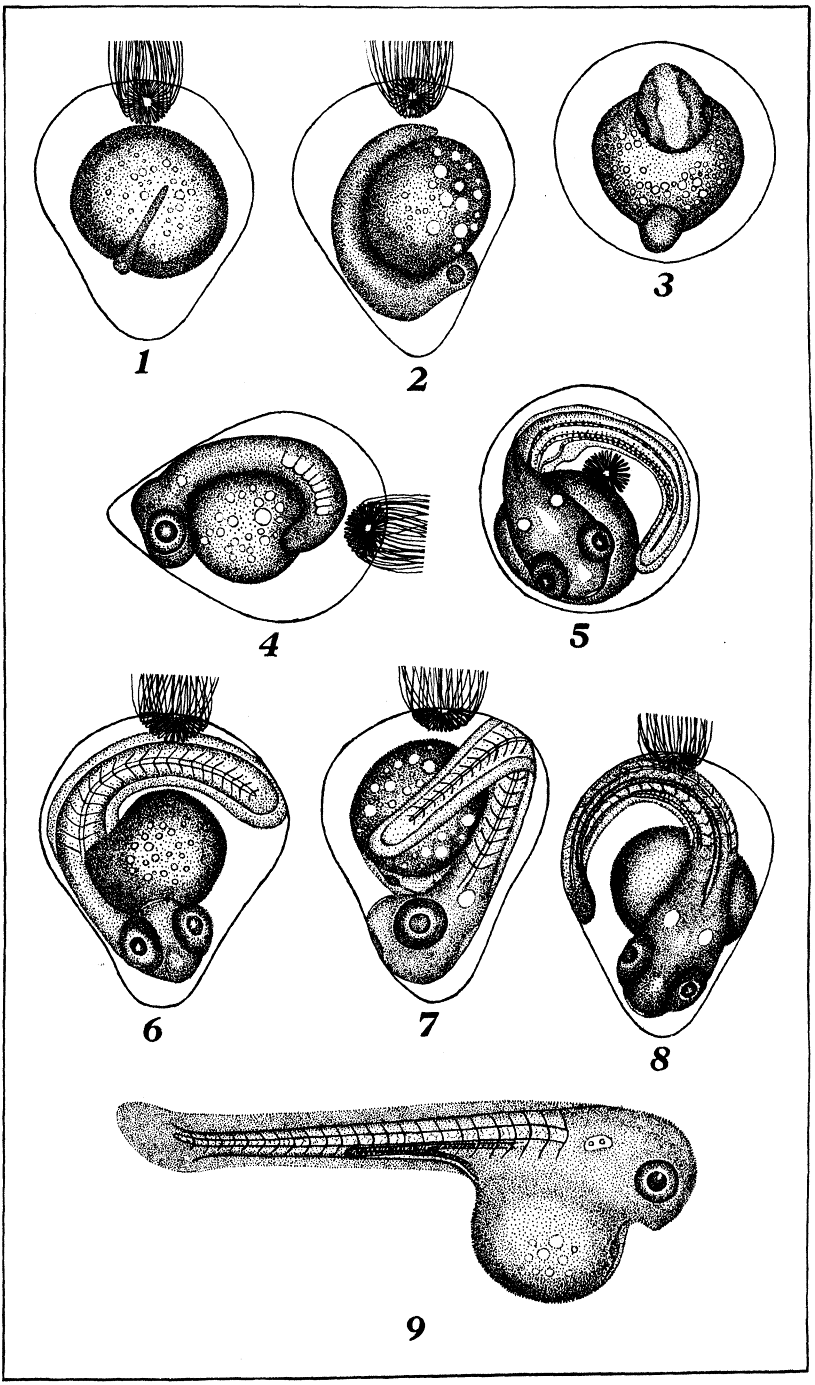

PLATE 2. MIROGOBIUS LACUSTRIS HERRE.

THE BREEDING ACTIVITIES AND EMBRYOLOGY OF APLOCHEILUS LUZONENSIS HERRE AND ABLAN

By GUILLERMO J. BLANCO

Of the Division of Fisheries
Department of Agriculture and Commerce, Manila

THREE PLATES

Aplocheilus luzonensis Herre and Ablan, a cyprinodont, is known among the Ilocanos as *coscosleng*. It abounds in rivers, streams, ponds, and ditches of the municipalities of Solsona, Batac, Laoag, Bacarra, and Dingras, Ilocos Norte Province. This fresh-water fish is generally not caught for food, but during scarcity of food fish it is taken advantage of by the inhabitants, especially those of the town of Solsona. This fish is voracious, feeding largely on mosquito larvæ, plankton, and organic detritus that float along littoral margins of shallow ponds and streams. Its flat head and transverse mouth are characteristic adaptations to surface feeding habits. Aside from its importance as a mosquito exterminator it may be kept as lively aquarium fish. Its small size and beautiful golden-yellow color at the proximal edges of the dorsal, anal, and caudal fins, especially during the breeding season, make it an attractive ornamental fish of distinct value.

Breeding activities.—Since the discovery of coscosleng as a new species of the family Cyprinodontidæ by Herre and Ablan in 1934, field study on the extent of its distribution and on the occurrence of its larvæ and young stages has been carried on. *Aplocheilus luzonensis* is known to breed throughout the year, but the height of the breeding season occurs in August. The coscosleng is in the habit of swimming in slow-running waters along littoral margins of ponds or streams where there is abundant vegetation of vallisneria, anacharis or other aquatic plants. This species in great numbers invariably congregate in water one to three feet deep. The males and females are not nest builders. On the other hand the eggs of females are provided with egg filaments. So far as known, such egg filaments are also developed in the developing egg of Atherinidæ, Phallostethidæ, and Gobiidæ.

The female of the species is recognized by the bulging of the flunk around the pectoral fins. The female is usually smaller

than the male, the latter having a larger head and a brighter golden-yellow color on the caudal and dorsal fins.

Breeding females usually carry clusters of eggs hanging in their oviduct. The outer egg membranes have numerous short adhesive threads and also a group of long filamentous threads arising from an area of the egg membrane. Such long filamentous threads are twisted and join other twisted threads of other eggs to form a single cord (Plate 1, fig. 1). A female which is ready to spawn is unusually active because she is being pursued by breeding males. When the female is ready to extrude eggs she becomes less active, preferring to settle at the gravelly bottom of a margin of a stream, rubbing off her abdomen on the gravel or peebles. She lies on a dorsolateral position at times followed by caudal fin vibrations until the eggs are extruded one at a time. A gravid female carries from 5 to 28 eggs (Table 1) depending upon the size of the female fish. Fertilization of the eggs is external as it was observed that ripe males followed females with extruded clusters of eggs. Clusters of eggs which are fertilized are either carried by the females until they are hatched or detached from the oviduct of the female fish and then attached to some plant leaves until they are hatched. In nature fertilized clusters of eggs which are not detached from the oviduct of the parent fish have more chances of being aërated, protected, and hatched than those clusters of eggs detached from the oviduct. Such eggs may be devoured by carnivorous fishes or other aquatic predatory species.

TABLE 1.—*Number of ripe ova in A. luzonensis.*

Length of fish in mm.	Number of eggs per fish	Length of fish in mm.	Number of eggs per fish
32	28	25	14
31	28	24	9
29	24	22	5
30	26	23	7
28	17	21	5
27	26	20	7
26	20	19	5

The breeding activities of this fresh-water cyprinodont appear to be characteristically different from those of other fresh-water species owing to the lack of copulatory external organs, as those found in the members of the family Phallostethidæ. The courtship prior to the spawning activity is not very apparent as that of the fresh-water species, which are nest-builders.

Aside from the field observations on the breeding activities of the coscosleng, the behavior of gravid females and adult males was also observed in a glass aquarium to facilitate the embryological study of *A. luzonensis.*

Embryology of A. luzonensis.—Clusters of eggs detached from the oviduct of the female fish were removed from aquatic plants and then transferred to watch glasses. Water from the aquarium was used daily up to the time of hatching. The observations and drawings were made with the aid of a camera lucida on all living materials. The incubation period of *A. luzonensis* in August, 1939, lasted from eight to ten days depending upon laboratory conditions.

The newly laid but unfertilized egg is transparent, about 1.5 mm in diameter, not globular, and has a narrow perivitelline space (Plate 1, fig. 2). The perivitelline space becomes wider a few hours after fertilization. One hour after fertilization the blastodisc (Plate 1, fig. 3) is apparently well differentiated, appearing as a protrusion of protoplasm at the pole of the yolk sphere. The oil globules are reduced in number and also occupy the mid portion of the yolk sphere. One and a half hours after fertilization meridional cleavage takes place (Plate 1, fig. 4), the blastodisc dividing into two equal daughter cells. About two and a half hours after fertilization the second plane of cleavage is apparent (Plate 1, fig. 5), thus cutting the first cleavage at right angles and dividing the blastodisc into four equal cells. After the eight cell-stage, cell division of the blastoderm was observed to be variable (Plate 1, fig. 6). The blastoderm continues to increase in diameter (Plate 2, fig. 1) until it covers a third of the yolk sphere. Twenty-five hours after fertilization the original primitive streak is very much advanced (Plate 2, fig. 2). Plate 2, fig. 3, shows a developing embryo forty-eight hours after fertilization. The embryo has developed eyes. Fifty-two hours after fertilization (Plate 2, fig. 4) the developing embryo has thirteen somites. An embryo, seventy-two hours old (Plate 2, figs. 5–6), has eighteen somites. At this stage the embryonic circulation is very much advanced; the notochord is very distinct; and the ear bones and brain are already in evidence, on the way to development.

The yolk sphere undergoes reduction, the number of somites increases to twenty-five, and the embryonic circulation is more advanced than in an embryo seventy-six hours after fertilization (Plate 3, fig. 1). One hundred hours after fertilization

the embryo as shown dorsally (Plate 3, fig. 2) has well-developed large eyes and ear bones. The pulsating heart, the smaller yolk-sphere, and the more or less continuous finfold are very much noticeable in the embryo one hundred twenty-four hours old (Plate 3, fig. 3). Seven days after fertilization (168 hours) the embryo begins to hatch by breaking the eggs shell through the process of wriggling inside the egg wall and finally hatching, tail first (Plate 3, fig. 4). The larva at the age of two days measures 5 mm long and has a well-developed pectoral and a single median fin that starts dorsally about the middle of the back and around the notochord up to the ventral surface. The larva has dark stellate pigment spots on the sides of the body (Plate 3, fig. 5).

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ILLUSTRATIONS

[Camera lucida drawings by the author.]

PLATE 1. APLOCHEILUS LUZONENSIS HERRE AND ABLAN

FIG. 1. Cluster of eggs; × 300.
2. A ripe egg; × 600.
3. An egg one hour after oviposition showing blastodisc; × 600.

FIGS. 4–6. Eggs showing multiplication of cells 3 to 4 hours after fertilization; × 600.

PLATE 2. APLOCHEILUS LUZONENSIS HERRE AND ABLAN

FIG. 1. Egg, 8 hours after fertilization; × 600.
2. Egg, 25 hours after fertilization showing advance primitive streak; × 600.
3. Developing embryo, 48 hours after fertilization; × 600.
4. Developing embryo, with thirteen somites, 52 hours after fertilization; × 600.

FIGS. 5–6. Embryos, 72 hours after fertilization, stages of embryo with 13–18 somites; × 600.

PLATE 3. APLOCHEILUS LUZONENSIS HERRE AND ABLAN

FIG. 1. Embryo, 76 hours after fertilization; × 600.
2. Embryo, 100 hours after fertilization; × 600.
3. Embryo, 124 hours after fertilization; × 550.
4. Embryo, 168 hours after fertilization; × 550.
5. Larva, 192 hours after fertilization; enlarged.

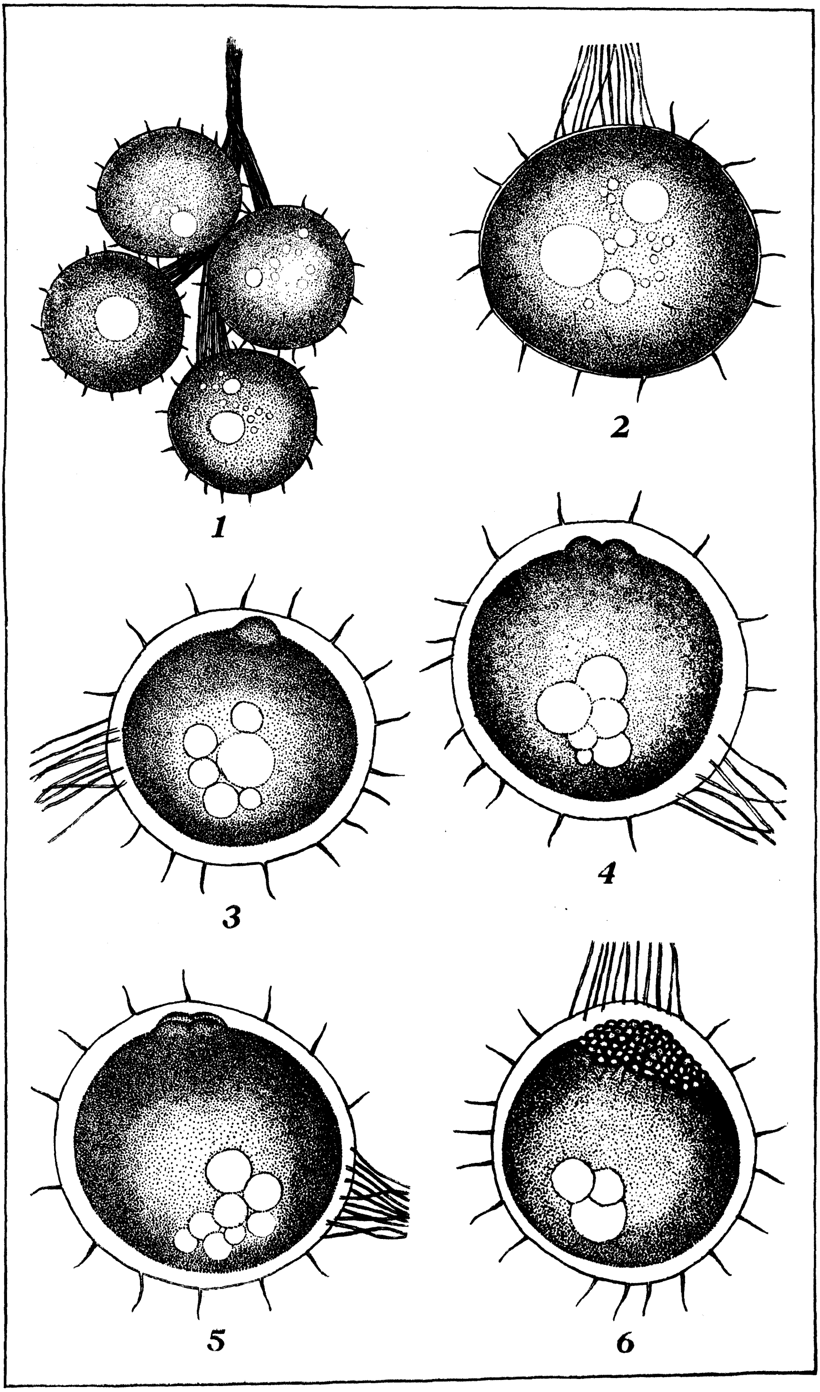

PLATE 1. APLOCHEILUS LUZONENSIS HERRE AND ABLAN.

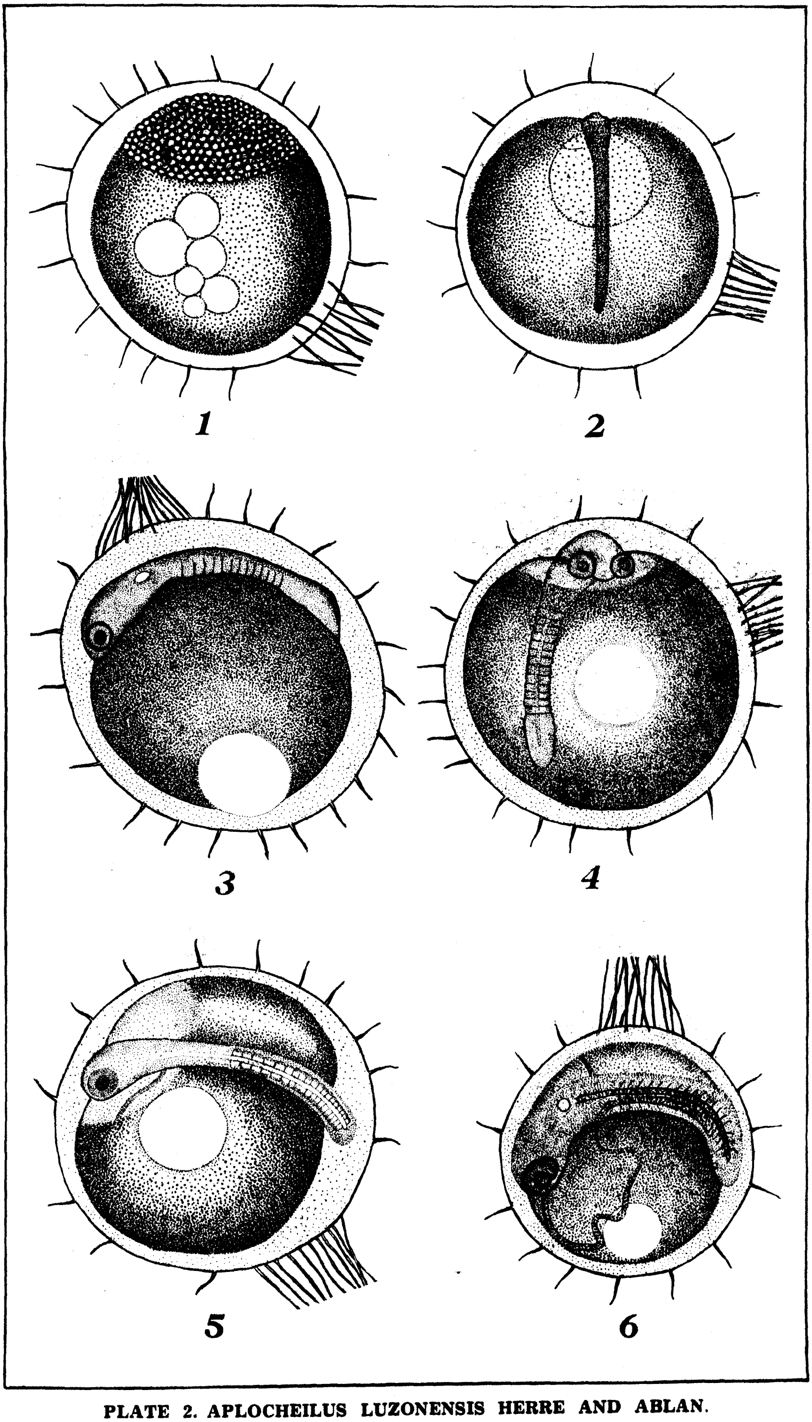

PLATE 2. APLOCHEILUS LUZONENSIS HERRE AND ABLAN.

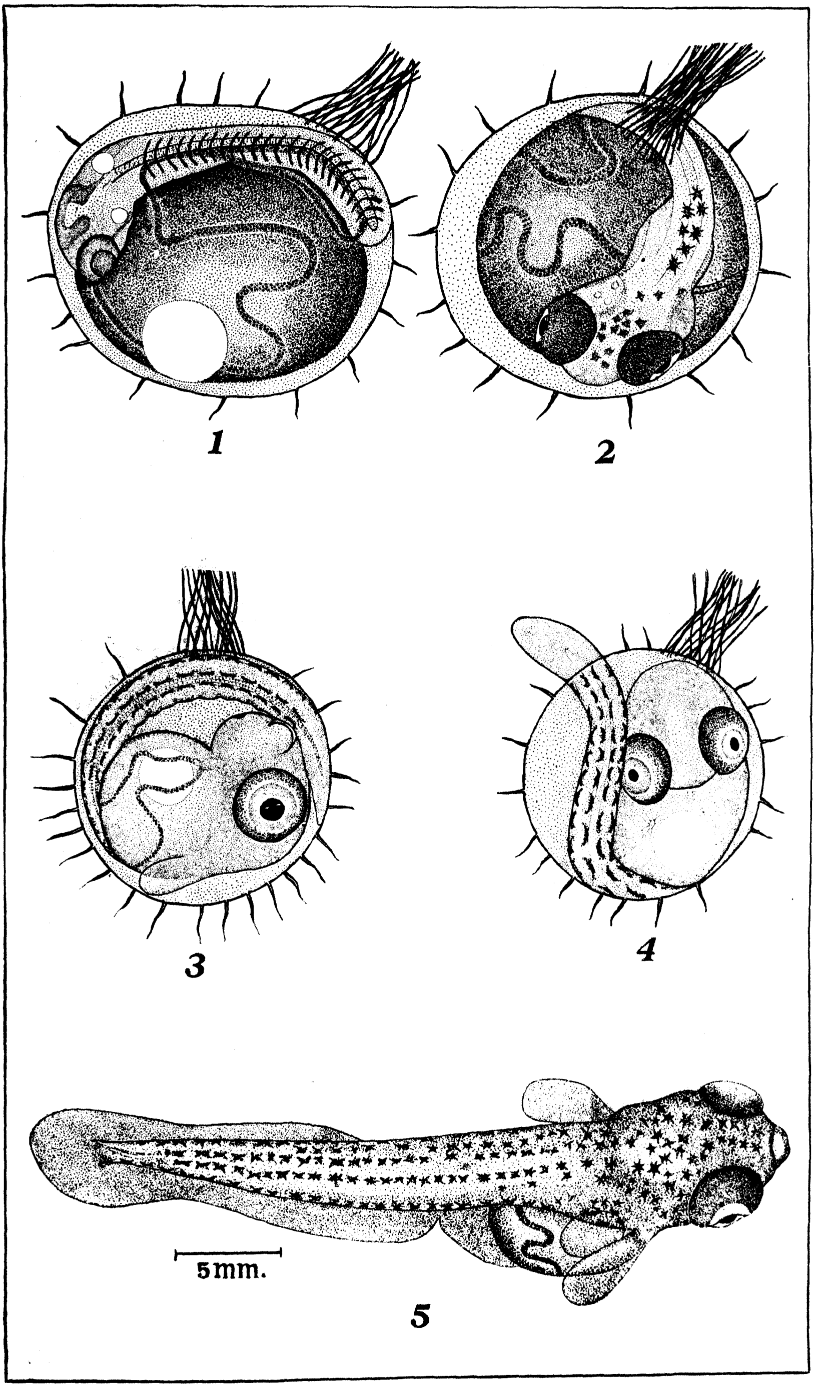

PLATE 3. APLOCHEILUS LUZONENSIS HERRE AND ABLAN.

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CYATHEA IN NEW GUINEA[1]

By EDWIN BINGHAM COPELAND

Of the University of California, Berkeley

FIFTEEN PLATES

The reasons provided by its present distribution for ascribing to *Cyathea* an Antarctic origin have been presented in this Journal.[2] In the same study, it was pointed out that migrants from Antarctica by the most open route to the Oriental tropics found in New Guinea their first opportunity for rich development under present climatic conditions. The hypothesis of Antarctic origin thus explains New Guinea's wonderful wealth and diversity of species in such a genus as *Grammitis;* and conversely, the local wealth of species endorses the hypothesis.

Cyathea is another such genus. In the enumeration to follow, I list 88 species—far more than are credited to any other like area. This list includes one species that is fairly surely reported there by error; two which I am unable to place in any systematic arrangement; three which may be misidentified; and still several so incompletely described that they may possibly be present under two names. Still, the number known can hardly be less than 80; since, if the species reported, for example, as *C. extensa* be not

[1] This paper includes a report on the ferns of this genus collected by the Third Archbold Expedition to New Guinea. For previous reports of this series, see Phil. Jour. Sci. **73** (1940) 345–357, 457–469; **75** (1941) 347–361; **76** (1941) 23–25.

Printer's proof of this paper was returned to Manila October 15, 1941. To protect the names, diagnoses of the new species were published in University of California Publications in Botany **18** (1942) 218, 219. I would not slander these diagnoses by saying that the descriptions and illustrations now published are necessary for the confident recognition of these species.

[2] Phil. Jour. Sci. **70** (1939) 180.

that species, it is probably another underscribed one. On the other hand, Brass's most recent collection, numbering 35, includes 15 described here as new, and such a proportion of novelties proves that the number still to be discovered is very large.

The genus is diversified, as well as rich in numbers, here. The dimorphous species constitute a considerable group. Several species are scandent, a phenomenon unknown elsewhere. One species is described as acaulescent; but the best of collectors might not be sure that this condition could not be outgrown. A considerable number of species have fronds remarkably small, for *Cyathea.*

One of these small-leaved species, *C. atrispora* Domin, was first named *Alsophila dryopteroidea* Brause. Brause satisfied himself that he saw a complete annulus. There is usually no difficulty in being sure as to any number of sporangia of a *Cyathea;* they are recognizable at a glance. A plant of Brass's collection, a tree-fern assigned at first to *Cyathea* without question, presented me the same problem; and I am assigning it to *Dryopteris,* in spite of one annulus which passed around the pedicel. Even if my observation and my assignment of the species are correct, it is as well not to be hasty in drawing conclusions.

At least throughout the Old World, most species of *Cyathea* are of very limited range, many of them known, each from a single mountain. They seem to be very incapable migrants. In harmony with this idea, is my experience with their spores, which I have tried very many times to germinate, but without success. The total number of individual collections of *Cyathea* in New Guinea is too small to justify any general conclusions as to their domestic range. Only as to the species of great altitudes it is worthy of note that several are now known from "Papua" and from Dutch New Guinea, respectively, at the east and west ends of the island.

As to the endemism of the island as a whole, it is very high. My list includes the off-shore islets—Aru, Run, Woodlark, even to the Louisiade Archipelago, which ought perhaps to be excluded. Only two well-known Malayan species, *C. contaminans* and *C. crenulata,* are known in New Guinea. The former is a group, rather than a species, but some of its New Guinea components occur also far to the west and northwest. The plant which has been reported as a variety of *C. tomentosa* is *C. ordinata,* a very distinct species. Two Polynesian species and one of New Caledonia have been reported, two of these from

the Louisiades only. As to all of these I am in doubt,—which is all that is permitted until one may compare the specimens named by Baker and Christ with authentic specimens of the species in question. Accepting all undisproved statements as to species common to New Guinea and to other lands, the local endemism seems to be above 90 per cent.

The most pleasing fact in work with New Guinea *Cyathea* is that a large part of the species have been described within the last thirty years, which is the period within which it has become usual to collect specimens which permit reasonably complete description. Brass's specimens sent me for study invariably include the base of the stipe, which is now recognized as essential for the purpose of description. No other land rich in *Cyathea* has so large a part of its species authentically known with this measure of completeness. These massive bases are indeed not convenient in the herbarium; but convenience is a very minor consideration, compared with the demand that the specimen gives as complete an idea as possible of the plant. Even this paramount demand can hardly be made to cover the trunk. In my own collections, for my own herbarium, are many pieces of trunk; but in collections by others, I am content, besides as much as possible of the lamina, with the stipe, and good field notes, as we have to be with trees of other kinds. In the descriptions of new species, to follow, the information in Brass's field notes is to be regarded as a part of each description.

Key to the species of Cyathea.

a^1. Indusium present.
- b^1. Pinnae 5–15 cm long; frond bipinnatifid.
  - c^1. Pinnae 15 cm long .... 1 *C. fusca.*
  - c^2. Pinnae 5–8 cm long.
    - d^1. Sorus bursting at apex .... 74. *C. Klossii.*
    - d^2. Indusium breaking up everywhere .... 75. *C. papuana.*
- b^2. Pinnules up to 3 cm long, flat, thin.
  - c^1. Stipe less than 5 cm long .... 70. *C. peranemiformis.*
  - c^2. Stipe longer.
    - d^1. Costae of pinnules hairy .... 66. *C. hunsteiniana.*
    - d^2. Costae naked .... 67. *C. Ledermanni.*
    - d^3. Costae squamulose.
      - e^1. Squamulae not bullate .... 68. *C. microphylloides.*
      - e^2. Squamulae mostly bullate .... 69. *C. perpelvigera.*
- b^3. Pinnules 1 cm long, coriaceous, not bullate .... 81. *C. arfakensis.*
- b^4. Pinnules under 4 cm long, more or less bullate.
  - c^1. Frond lanceolate, bipinnate .... 81. *C. arfakensis.*
  - c^2. Frond lanceolate, tripinnatifid .... 80. *C. imbricata.*
  - c^3. Frond lanceolate to ovate, tripinnate.

d^1. Basal paleae flat, pale-marginate .... 77. *C. cheilanthoides.*
d^2. Basal paleae twisted or crinite, concolorous.
e^1. Secondary pinnules mostly oblong .... 78. *C. Macgregori.*
e^2. Secondary pinnules mostly round .... 79. *C. gleichenioides.*
c^4. Frond broadly ovate, quadripinnate .... 76. *C. Keysseri.*
b^5. Pinnules larger, segments bullate or cucullate .... 34. *C. ordinata.*
b^6. Pinnules larger, not bullate nor deeply cut.
c^1. Indusium firm .... 1. *C. fusca.*
c^2. Indusium membranous .... 2. *C. Werneri.*
b^7. Pinnules over 4 cm long, not bullate, deeply pinnatifid or pinnate at base only.
c^1. Segments 4 mm wide or wider.
d^1. Tomentum on rachis not mixed with paleae.
e^1. Pinnae up to 35 cm long .... 3. *C. Rosenstockii.*
e^2. Pinnae up to 55 cm long .... 4. *C. runensis.*
d^2. Tomentum mixed with linear paleae .... 5. *C. subspathulata.*
c^2. Segments less than 4 mm wide.
d^1. Costa of pinnule naked beneath.
e^1. Secondary rachises naked beneath .... 6. *C. pruinosa.*
e^2. Secondary rachises very scaly .... 7. *C. costalisora.*
d^2. Costa bearing bullate paleae only.
e^1. Sori costular .... 8. *C. geluensis.*
e^2. Sori medial .... 9. *C. novoguineensis.*
d^3. Costa bearing bullate and narrow flat paleae.
8. *C. geluensis* var. *tomentosa.*
d^4. Costa bearing mixed dark-setulose paleae...... 13. *C. Foersteri.*
d^5. Costa bearing bullate and large flat paleae.
e^1. Paleae on costa dense .... 11. *C. rigens.*
e^2. Paleae on costa sparse .... 12. *C. everta.*
d^6. Costa scaly and hairy .... 10. *C. sepikensis.*
d^7. Costa hairy, without scales .... 14. *C. cincinnata.*
b^8. Pinnules ample, not bullate, pinnate.
c^1. Upper surface of lamina white-squamulose .... 15. *C. procera.*
c^2. Upper surface bearing white fibers.
d^1. Secondary pinnules entire or subentire.... 16. *C. albidosquamata.*
d^2. Secondary pinnules pinnatifid .... 71. *C. pulcherrima.*
c^3. Upper surface naked.
d^1. Secondary pinnules not deeply cut.
e^1. Tertiary rachis (costa of primary pinnule) glabrescent.
f^1. Segments deeply crenate .... 17. *C. Muelleri.*
f^2. Segments entire .... 52. *C. fugax.*
e^2. Tertiary rachis scaly beneath.
f^1. Pinnules sparsely squamulose beneath.
g^1. Secondary pinnules incised.
h^1. Rachis furfuraceous .... 18. *C. Archboldii.*
h^2. Rachis long-scaly .... 19. *C. bidentata.*
g^2. Secondary pinnules entire to crenulate.
h^1. Rachis 6 mm thick at base .... 20. *C. globosora.*
h^2. Rachis over 15 mm thick .... 21. *C. pachyrrhachis.*
f^2. Pinnules densely tomentose beneath .... 22. *C. percrassa.*
d^2. Secondary pinnules deeply cut at base.

e[1]. Secondary pinnules 2 mm wide above base.... 23. *C. auriculifera.*
e[2]. Secondary pinnules wider (over 3 mm) .... 24. *C. macrophylla.*
d[3]. Lower secondary pinnules subpinnate.. 25. *C. quadripinnatifida.*
a[2]. Indusium wanting or reduced to a concealed scale.
b[1]. Fertile and sterile pinnules not very unlike.
c[1]. Trunk erect and self-supporting.
d[1]. Pinnae pinnatifid.
e[1]. Veinlets less than 15 pairs .... 56. *C. atrispora.*
e[2]. Veinlets 30 pairs .... 83. *C. Woodlarkensis.*
d[2]. Pinnules up to 3 cm long.
e[1]. Pinnules pinnatifid at base only .... 84. *C. recurvata.*
e[2]. Pinnules pinnatifid or pinnate throughout.
f[1]. Segments bullate .... 82. *C. tomentosissima.*
f[2]. Segments flat.
g[1]. Paleae on stipe fuscous, broad .... 72. *C. lepidoclada.*
g[2]. Paleae stramineous, 1–2 mm wide .... 73. *C. parva.*
d[3]. Pinnules larger, with at most one secondary pinnule.
e[1]. Segments 7 mm wide .... 26. *C. marginata.*
e[2]. Segments about 4 mm wide.
f[1]. Rachis smooth.
g[1]. Rachis scaly beneath .... 27. *C. rubiginosa.*
g[2]. Rachis naked beneath .... 29. *C. Macgillivrayi.*
f[2]. Rachis muricate.
g[1]. Rachis scaly beneath .... 28. *C. albidula.*
g[2]. Rachis pubescent beneath .... 30. *C. geppiana.*
e[3]. Segments less than 4 mm wide.
f[1]. Rachis smooth .... 31. *C. Wilkesiana.*
f[2] Rachis rough.
g[1]. Costae persistently paleate beneath.
h[1]. Texture herbaceous, thin .... 32. *C. scaberula.*
h[2]. Texture firm to coriaceous.
i[1]. Costal paleae dark or mixed.
j[1]. Pinnules stalked .... 33. *Als. arfakensis.*
j[2]. Pinnules sessile.
k[1]. Larger paleae entire .... 34. *C. ordinata.*
k[2]. Paleae lacerate .... 35. *C. magna.*
i[2]. Costal paleae all pale.
j[1]. Larger paleae 2–5 mm long .... 36. *C. horridula.*
j[2]. Paleae up to 1 mm long.
k[1]. Frond dark green .... 37. *C. scabriseta.*
k[2]. Frond light green .... 38. *C. Brassii.*
g[2]. Costae naked or glabrescent beneath.
h[1]. Basal scales ferruginous or paler.
i[1]. Texture herbaceous .... 39. *C. scaberulipes.*
i[2]. Firm to coriaceous.
j[1]. Veins persistently hairy beneath.... 40. *C. pilulifera.*
j[2]. Veins deciduously hairy .... 41. *C. aeneifolia.*
j[3]. Veins not hairy.
k[1]. Sori costular .... 42. *C. gregaria.*
k[2]. Lower sori medial .... 43. *C. tenuicaulis.*

h^2. Basal scales dark.
i^1. Pinnules stalked .... 44. *C. brauseana.*
i^2. Pinnules sessile.
j^1. Wing of costa 1 mm wide .... 45. *C. wengiensis.*
j^2. Wing very narrow.
k^1. Segments naked beneath .... 46. *C. Dielsii.*
k^2. Veins hairy and scaly .... 47. *C. melanacantha.*
d^4. Pinnules pinnate.
e^1. Rachis muricate to spiny.
f^1. Secondary pinnules symmetrical at base.
g^1. Basal paleae dark.
h^1. Costular paleae bullate, entire, pale .... 48. *C. extensa.*
h^2. Paleae few, pale, flat .... 49. *C. intermedia.*
h^3. Costular paleae many, dark .... 50. *C. atrox.*
g^2. Basal paleae light .... 51. *C. contaminans.*
f^2. Secondary pinnulae subhastate .... 53. *C. truncata.*
e^2. Rachis smooth.
f^1. Rachis stramineous .... 54. *C. eminens.*
f^2. Rachis atropurpureous .... 55. *C. atropurpurea.*
c^2. Trunk wanting .... 56. *C. atrispora.*
c^3. Trunk weak, scandent.
d^1. Axes brown .... 57. *C. ascendens.*
d^2. Axes blackish .... 58. *C. scandens.*
b^2. Dimorphous, fertile pinnules contracted.
c^1. Sterile pinnules at most crenate .... 59. *C. biformis.*
c^2. Sterile pinnules pinnatifid.
d^1. Sterile segments 5 mm wide.
e^1. Costal squamules flat, dentate-ciliate .... 60. *C. Schlechteri.*
e^2. Costal squamules bullate, entire .... 61. *C. dimorphophylla.*
d^2. Sterile segments narrow.
e^1. Fertile pinnulae under 2 cm long .... 62. *C. brunnea.*
e^2. Fertile pinnulae up to 5 cm long .... 63. *C. gracillima.*
c^3. Sterile pinnules pinnate.
d^1. Lamina glabrous .... 64. *C. olivacea.*
d^2. Lamina squamulate .... 65. *C. melanoclada.*

1. CYATHEA FUSCA Baker.

C. fusca BAKER, Malesia 3 (1886) 31.
C. Kingii ROS., Fedde's Repert. 9 (1911) 422.

Known only in eastern New Guinea (Papua): *King 181, 277* (type of *C. Kingii* Ros.), *376, 383; Brass 5137.* In full development, this species has pinnæ up to 40 cm long, pinnules up to 8 cm long, cut 2/3 of the way to the costa into broad, rounded or obliquely acute lobes. *King 383* has pinnæ 15 cm long, merely deeply lobed, but I feel sure that it is a form of the same species. *Brass 5137* has a long series of pinnatifid basal pinnæ, above which it is widened and bipinnatifid. The pinnæ are more or less distinctly articulate to the rachis.

2. CYATHEA WERNERI Ros.

C. Werneri ROS., Fedde's Repert. 5 (1908) 34.
C. Versteegii CHRIST, Nova Guinea 8 (1909) 161.

KAISER-WILHELMSLAND: Damun, altitude 500 meters, *Werner 66*, isotype in Herb. Univ. Calif.; *Schlechter 16388*. The type of *C. Versteegii* is *Versteeg 1190*, not seen. Aside from the fact that I cannot distinguish these two species, neither is very distinct from *C. fusca*. Because its indusium is fugitive, I refer here *Carr 12133*, very large, received as *C. fusca*.

3. CYATHEA ROSENSTOCKII Brause.

C. Rosenstockii BRAUSE, Engler's Jahrb. 56 (1920) 49.

Sepik region, altitude 1,300 meters, *Ledermann 11264*, isotype in Herb. Univ. Calif.; Idenburg River, altitude 1,750 meters, *Brass 12275*.

4. CYATHEA RUNENSIS v. A. v. R.

C. runensis v. A. v. R., Bull. Dept. Agr. Indes Neerl. No. 18 (1908) 1.

Pulu Run, northwest of New Guinea, *Teysmann;* known by the one collection.

5. CYATHEA SUBSPATHULATA Brause.

C. subspathulata BRAUSE, Engler's Jahrb. 56 (1920) 53.

Sepik region, altitude 2,070 meters, *Ledermann 11623*, not seen.

6. CYATHEA PRUINOSA Ros.

C. pruinosa ROS., Fedde's Repert. 12 (1913) 163.

Bolan Mts., altitude 2,400 to 3,000 meters, *Keysser* (1912) *B. 44*, isotype in Herb. Univ. Calif.; not again reported.

7. CYATHEA COSTALISORA Copeland. Plate 1.

C. costalisora COPELAND, U. C. Publ. Bot. 18 (1942) 218.

Arbor, trunco teste Brassio 4 m alto, sursum 6 cm crasso; stipite ca. 25 cm longo, ubique rhachique paleis 1–2 cm longis anguste linearibus vel acicularibus atris brunneo-marginatis dense vestitis; lamina 70 cm longa, 35 cm lata, acuta, tripinnatifida, pinnis infimis 10 cm longis deflexis, medialibus 20 cm longis, 7 cm latis, sessilibus, subacuminatis, rhachibus superne ferrugineo-tomentosis, inferne paleis ca. 4 mm longis linearibus plerisque curvis vel tortis linea mediale atris marginibus ferrugineis densis immersis; pinnulis sessilibus, 4 cm longis, 1 cm latis, acutis, vix ad costam pinnatifidis, costa superne ferrugineo-tomentellis, inferne nudis, segmentis 2 mm latis, contiguis,

praecipue apices versus conspicue crenato-denticulatis, papyraceis, obscuris vel inferne pallidioribus, venis conspicuis, ca. 7-paribus, plerisque furcatis; soris costularibus ad venas infimas restrictis, ideo ad basin segmenti cujusque geminatis, rarius biparibus, parvis, indusio symmetrice truncato persistente.

DUTCH NEW GUINEA: Lake Habbema, altitude 3,225 meters, *Brass No. 9488*. "Occasional in forests of moist hollows; stem branching from near base; fronds spreading; material from branch with 9 fronds."

Remarkable for the dense coat of slender paleæ, brown or dark brown in mass as the color of the margins predominates on the minor axes but not on the stipe, the naked costæ, and the minute sori strictly basal on the segments, against the costa of the pinnule. Not evidently near any other known species.

8. CYATHEA GELUENSIS Ros.

C. geluensis ROS., Fedde's Repert. 5 (1908) 371.

Mt. Gelu, altitude 1,000 meters, *Werner* (1907) *80*, isotype in Herb. Univ. Calif. The stipe and lower part of the type plant are unknown. Our specimen is the apical 25 cm, and a pair of pinnæ from somewhat lower. These show that the entire frond was small. Subsequently described is var. *tomentosa*,[3] from Sattelberg, altitude 1,400 to 1,500 meters, *Keysser 178;* of this we have two isotypes, as it was distributed under another label as *Fil. Novoguin. exsic n. 202*. We have also *Keysser 178a*, labelled var. *subpaleacea*, apparently never published. If var. *tomentosa* is *C. geluensis*, it is a widely variable species.

Suspecting that this is so, I refer to it *Brass 12919* and *13345*, Idenburg River, altitude 1,200 and 850 meters. These are excellent specimens of a much larger plant than the original. Trunk (Brass's notes) 2.8 m and 7–8 m tall, 6–7 cm in diameter; stipe short, about 10 cm; the lower pinnæ gradually reduced, even to 4 cm long, paleæ of stipe 2.5 cm long, 2 mm wide, attenuate, stramineous; middle pinnæ 50–60 cm long, 15 cm wide, subsessile, acuminate, almost bipinnate, the lowest segments disconnected but adnate, rachis of pinna minutely strigose above, with an appressed tangled pale tomentum beneath, mixed with occasional narrowly linear paleæ 5 mm long; costæ clothed beneath with whitish scales 1–2 mm long, which, on *No. 13345*, almost all consist of round bullate bases and very long setæ, as on the type of *C. geluensis* except that its scales are less abundant and the distinction of base and seta is less

[3] Fedde's Repert. 12 (1913) 525.

sharp. Rarely, the base of a scale is missing, and it becomes a hair, or the seta is missing and the scale is round. On *No. 12919*, scales reduced to hairs are numerous. The differences between these specimens and typical *C. geluensis* are in degree, in size, density of scaliness, etc.; and for the present they may best be regarded as that species, in a more perfect development than its type represents.

9. CYATHEA NOVOGUINEENSIS Brause.

C. novoguineensis BRAUSE, Engler's Jahrb. 49 (1912) 12, fig. 1 B.

Bismarck Mts., altitude 1,800 meters, *Schlechter 18697*, isotype in Herb. Univ. Calif. Not again reported.

10. CYATHEA SEPIKENSIS Brause.

C. sepikensis BRAUSE, Engler's Jahrb. 56 (1920) 54.

Sepik region, altitude 2,070 meters, *Ledermann 11751.* Not seen; but I have *Carr 14432*, from Boridi, altitude 4,700 feet, bearing this name; it is within the range of variation which I ascribe to *C. geluensis.*

11. CYATHEA RIGENS Ros.

C. rigens ROS., Fedde's Repert. 12 (1913) 163.

Bolan Mts., altitude 2,400 to 3,000 meters, *Keysser* (1912) *B. 79*, isotype in Herb. Univ. Calif. Not again reported.

12. CYATHEA EVERTA Copeland. Plate 2.

C. everta COPELAND, U. C. Publ. Bot. 18 (1942) 218.

C. rigenti subsimilis, rhachibus pinnarum squamis pluribus costis pinnularum paucioribus vestitis distincta; trunco typi teste Brassio, 5 m alto; stipite 20 cm longo, basi trunco appresso, sursum everto horizontale, basi paleis 2 cm longis basi brunneo 2 mm latis primo nigro-ciliatis denique erosis apice nigrescentibus attenuatis vestito, sursum pallide furfuraceo vel glabrescente, aculeato; lamina 90 cm longa, acuminata, rhachi superne fusco-tomentosa, inferne pallide furfuracea; pinnis infimis fere 15 cm longis vix deflexis, medialibus 30 cm longis, 7–10 cm latis, imbricatis, sessilibus, acuminatis, vix bipinnatis, rhachibus superne fusco-tomentosis, inferne pilis squamulisque amorphis pallidis tenuiter furfuraceis et paleis nonnullis angustissimis sparsis; pinnulis 4 cm longis 1 cm latis, sessilibus vel infimis brevi-pedicellatis, acutis, costis superne tenuiter fusco-tomentosis, inferne squamulis minutis amorphis et majoribus 1–2 mm longis ovatis acuminatis stramineis sparsis; segmentis basi 3 mm alibi 2 mm latis, subfalcatis, obtusis, ubique vel apice tan-

tum denticulatis, superne atro-viridibus, inferne pallidioribus, firme papyraceis, costulis inter soros squamuliferis alibi nudis; venis ca. 8-paribus, plerisque furcatis, inconspicuis; soris costularibus, 3–6-paribus, indusiis ruptis calyce plus minus irregulare persistente.

DUTCH NEW GUINEA: 9 kilometers northeast of Lake Habema, altitude 2,800 meters, *Brass No. 10712*, type. "Common in mossy forest of slopes; slender tree fern; leaves 5 or 6, flat-spreading, 120–140 cm long;" also, Bele River, altitude 2,300 meters, *No. 11415*, occasional in moist hollows in Fagaceæ-forest, 2 m tall.

Much like *C. rigens*, but the tomentum darker, the secondary rachises more scaly, the costæ and costules less so. *No. 11415* has a dwarfed pinna growing out of the mass of basal paleæ.

13. CYATHEA FOERSTERI Ros.

C. Foersteri ROS., Fedde's Repert. 10 (1912) 321.

Sattelberg, altitude 1,600 meters, *Keysser* (1911) *16*, not seen. Particularly characterized by mixed pale paleæ on costæ and costulæ, the larger ones dark-ciliate, the smaller ones with dark setæ on back and margin. *Brass 4971*, Mt. Tafa, altitude 2,400 meters, is identified by Christensen[4] as this species. It is tripinnate, with several pairs of secondary pinnules at the base of the primary, and is sparsely, instead of densely, scaly; but it does have the dark bristles on the sparse paleæ. Such paleæ occur also on *C. macrophylla* and *C. Archboldii*, and the larger paleæ of *C. everta* bear a few dark bristles.

14. CYATHEA CINCINNATA Brause.

C. cincinnata BRAUSE, Engler's Jahrb. 56 (1920) 52.

Sepik region, altitude 1,300 meters, *Ledermann 11200, 11279*. Not seen.

Species 6 to 14 belong to a natural group, to which a number of the following show evidences of affinity.

15. CYATHEA PROCERA Brause.

C. procera BRAUSE, Engler's Jahrb. 56 (1920) 50.

Sepik region, altitude 2,070 meters, *Ledermann 11856, 11879*, not seen. Said to be near *C. Foersteri*.

16. CYATHEA ALBIDOSQUAMATA Ros.

C. albidosquamata ROS., Fedde's Repert. 12 (1913) 525.

Sattelberg, altitude 1,400 to 1,500 meters, *Keysser* (1913) *177*, isotype in Herb. Univ. Calif.

[4] Brittonia 2 (1937) 279.

17. CYATHEA MUELLERI Baker.

C. Muelleri BAKER, Jour. Bot. 28 (1890) 104.

Type from Mt. Knutsford, *Macgregor.*

Because the description does not show why this may not be done, I refer to this species *Brass 9423* and *9430* and *Brass & Myer-Drees 10023,* all from about Mt. Wilhelmina, altitude 3,200 to 3,650 meters. Trunk 3–4 m tall, 20 cm thick, bearing many fronds; stipe 10–25 cm long, densely immersed in narrowly linear-aculeate shiny castaneous paleæ 7 cm long; lamina 75 cm long, 35 cm wide, freely tripinnate, naked except on the back of the minor rachises; rachis brown, slightly muriculate in the lower part, with conspicuous "glands" beside the bases of the pinnæ; pinnæ 25 cm long, 6 cm wide, short-stalked, imbricate, lower pinnæ reduced; primary pinnules 6 cm long, 16 mm wide, stalked, acute; secondary pinnules 10 mm long, 2.5–3 mm wide, apex rounded, the lower ones incised hardly half-way to the costa and the lobes emarginate, black green above (dried), brownish beneath, coriaceous, flat or somewhat bullate where freely soriferous; sori up to 5 pairs, costal, indusium firm, breaking into coarse pieces. Imbricate throughout, the denseness giving it a coarse appearance in spite of its moderate size. Remarkable also for the mass of dark, shining, needlelike basal paleæ, and for its nakedness elsewhere.

17a. CYATHEA CRENULATA Blume.

Cyathea crenulata Blume is not reported from New Guinea, but we have *Schlecter 16949,* Kani Mts., altitude 1,000 meters, so named. The specimen is not complete but seems to be correctly identified.

18. CYATHEA ARCHBOLDII C. Chr.

C. Archboldii C. CHR., Brittonia 2 (1937) 278.

Central Division: Murray Pass, altitude 2,840 meters, *Brass 4551.*

Remarkable for the abundance of brown-black setulæ on lighter-brown squamules.

19. CYATHEA BIDENTATA Copeland. Plate 3.

C. bidentata COPELAND, U. C. Publ. Bot. 18 (1942) 218.

Trunco teste Brassio 3.5 m alto, 7 cm crasso; stipitis parte missa 35 cm longa, 15 mm crassa, paleis ochroleucis deorsum 3 cm longis basi (palearum) 4 mm latis deinde attenuatis apice filiformibus sursum minoribus integris ubique dense immersa; lamina abrupte acuminata, rhachi infra paleas densas castaneas

1 cm longas anguste lineares margine pallidiores erosas furfuracea; pinna mediale ca. 60 cm longa, 15 cm lata, subsessile, patente, rhachi frondis simile, paleis decrescentibus dense vestita; pinnulis[i] 8 cm longis, 1.5 cm latis, sessilibus, apice acuminatis, alibi pinnatis, costis superne minute strigosis inferne paleis lanceolatis castaneis 1–2 mm longis dense vestitis; pinnulis[ii] contiguis non confluentibus, 3 mm latis, obtusis, ca. $\frac{1}{3}$ ad costam incisis, lobis apice (fissis) bidentatis, superne atro- inferne fusco-viridibus, coriaceis glabris; soris costalibus, indusiis fuscis persistentibus.

DUTCH NEW GUINEA: 9 kilometers northeast of Lake Habbema, altitude 2,750 meters, *Brass No. 10971*. "Frequent in forest of lower slopes; stem slender . . .; leaves 10, curved and spreading, 2.5 m long including stipes of 0.5 m; bases of stipes not persistent."

Unlike any other species known to me, in scaliness and in dissection.

20. CYATHEA GLOBOSORA Copeland. Plate 4.

C. globosora COPELAND, U. C. Publ. Bot. **18** (1942) 218.

Arbor sciadomorpha, trunco teste Brassio 7–8 m alto, 5–6 cm crasso; stipite 40 cm longo, basi vix 1 cm crasso, basi imo paleis 2 cm longis 1.5 mm latis linea mediale nigris stramineo-marginatis, paleis sequentibus 3 mm latis stramineis supra mediam longitudinem fusco-costulatis apicibus setaceis fuscis, sursum paleis sparsioribus omnino stramineis vestito, superne late sulcato fusco-tomentoso, inferne spinis deorsum 1.5 mm longis sparsis sursum decrescentibus munito; lamina abrupte acuminata, rhachi deorsum 6 mm crassa, superne purpureo-fusco-tomentosa, sulcato, lateribus paleis stramineis ornata, inferne fulvo, fulvo-furfuracea; pinnis infimis 15 cm longis breviter (1 cm) stipitulatis, deflexis, medialibus late patentibus, 35 cm longis, 12 cm latis, breviter acuminatis, bipinnatis, rhachibus inferne paleis stramineis usque ad 7 mm longis persparsis ornatis aliter pallide furfuraceis; pinnulis[i] 6.5 cm longis, 12 mm latis, sessilibus, caudato-acuminatis, rhachillis inferne deorsum paleis 1–2 mm longis sparsis, minute furfuraceis; pinnulis[ii] 2.5–3 mm latis, oblique subacutis, crenulatis, coriaceis, superne atroviridibus, inferne brunnescenti-viridibus, glabris, venis plerisque furcatis; soris 4–6–paribus, indusiis globosis, brunneis, persistentibus.

DUTCH NEW GUINEA: 9 kilometers northeast of Lake Habbema, altitude 2,750 meters, *Brass No. 1077*. "Plentiful in for-

ests of slopes; slender tree-fern . . .; leaves flat-spreading, 120–150 m long."

An exceptionally slender tree-fern, notable also for the extension of pale paleæ to the minor axes, and for the dark middle-lines complete or only distal, on the basal paleæ. *Cyathea everta* has basal paleæ in part similar.

21. CYATHEA PACHYRRHACHIS Copeland. Plate 5.

C. pachyrrhachis COPELAND, U. C. Publ. Bot. 18 (1942) 218.

Arbor, trunco teste Brassio 7 m alto, 7.5 cm crasso; stipite 40 cm longo, sicco fere 2 cm crasso, purpureo-fusco, dense muriculato, superne ad latera sulcæ paleis stramineis 1.5 cm longis lineari-acicularibus deciduis vestito; fronde grande, apice abrupte acuminata, rhachibus stipiti conformibus; pinnis infimis 20–25 cm longis, deflexis, stipitulis 5 cm longis, medialibus subsessilibus, 60 cm longis, 18 cm latis, acuminatis, bipinnatis; pinnulis$^{\text{i}}$ 9.5 cm longis, 15 mm latis, sessilibus, acuminatis, rhachillis superne tomentosis, inferne paleis 2–3 mm longis lanceolatis castaneis maximis pallidius marginatis dense vestitis; pinnulis$^{\text{ii}}$ 3 mm latis, obtusis, inciso-crenatis vel inciso-dentatis, superne nigrescentibus inferne brunneo-viridibus, coriaceis, costulis deorsum squamulatis aliter glabris, venis furcatis; soris plerisque 5-paribus, contiguis, indusiis brunneis, globosis, mox fissis, deinde persistentibus.

DUTCH NEW GUINEA: 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1,800 meters, *Brass No. 12118.* "Open situation in a forested gulley . . .; leaves 10, spreading, stipes not persistent, scars oval."

Notable for stout stipe and rachis densely beset with minute blunt points, which indicate that it is densely paleate in vernation; but remarkable few paleæ persist, even at the base.

22. CYATHEA PERCRASSA C. Chr.

C. percrassa C. CHR., Brittonia 2 (1937) 279.

Mt. Albert Edward, altitude 3,500 meters, *Brass 4375.* Well characterized by "its extremely coriaceous texture and by the under side of the pinnae being densely covered with an appressed tomentum consisting of small fimbriate rufous scales with atropurpureous setæ." Related to *C. Foersteri.*

23. CYATHEA AURICULIFERA Copeland.

C. auriculifera COPEL., Phil. Jour. Sci. 6 (1911) Bot. 364.

Goodenough Bay, altitude 1,200 meters, *King 227.* The type is at present out of reach, on loan.

24. **CYATHEA MACROPHYLLA Domin.**

C. macrophylla DOMIN, Acta Bot. Bohem. 9 (1930) 133.
Hemitelia Ledermanni BRAUSE, Engler's Jahrb. 56 (1920) 60.

Sepik region, altitude 1,400 to 1,500 meters, *Ledermann 12533, 12925b;* Tsuarafa, altitude 4,500 feet, *Carr 15329,* det. Alston. Near *C. auriculifera,* but larger, and distinct in several details.

25. **CYATHEA QUADRIPINNATIFIDA Copeland. Plate 6.**

C. quadripinnatifida COPELAND, U. C. Publ. Bot. 18 (1942) 218.

Arbor, trunco teste Brassio 2 m alto, 7.5 cm crasso, fronde stipite (1.1 m) incluso 6 m longa; stipite sicco 1.5 cm crasso, deorsum paleis 4 cm longis anguste linearibus albis nitentibus integris densis immerso, alibi fulvo-furfuraceo, spinis paucis parvis armato; lamina acuminata, rhachibus inferne furfuraceis sat dense spinosis; pinna mediale 1 m longa, 28 cm lata, stipitulo 2 cm longo; pinnulis^{i} non contiguis, breviter stipitulatis, horizontalibus, 14 cm longis, 2.4 cm latis, acuminatis, deorsum profunde bipinnatifidis, rhachilla superne tomentosa, inferne squamulis amorphis furfuracea et paleis 1 mm longis ovatis setaceis peltatis pallide marginatis linea mediale et acumine castaneis castaneo-ciliatis vestita; pinnulis^{ii} brevissime stipitulatis, superioribus 3 mm latis obtusis crenatis, inferioribus 5 mm latis deorsum fere ad costam pinnatifidis, coriaceis, utraque facie bruneo-viridibus, costis superne glabris, inferne squamulis parvis imbricatis ovatis castaneis pallidius marginatis apice atrocastaneo-ciliatis vestitis, segmentis 1 mm latis obtusis; pinnulis^{ii} fertilibus gracilioribus, inferioribus basi auriculatis alibi tantum crenatis; soris ca. 8–paribus, costalibus, contiguis, indusiis tenuibus sed persistentibus.

DUTCH NEW GUINEA: 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 175 meters, *Brass No. 12225.* "Rather open slopes of a rain-forest ravine. Tree fern with exceptionally long leaves."

Remarkable also for the dissection of the fronds. The rachises seem to be more spinose than the stipe.

26. **CYATHEA MARGINATA (Brause) Domin.**

C. marginata (Brause) DOMIN, Acta Bot. Bohem. 9 (1930) 134.
Alsophila marginata BRAUSE, Engler's Jahrb. 56 (1920) 63.

Sepik region, altitude 1,400 to 1,500 meters, *Ledermann 12586.* Not seen; "Steht keiner anderen Art nahe."

27. **CYATHEA RUBIGINOSA (Brause) Domin.**

C. rubiginosa (Brause) DOMIN, op. cit., p. 154.
Alsophila rubiginosa BRAUSE, Engler's Jahrb. **56** (1920) 66.

Sepik region, altitude 1,400 to 1,500 meters, *Ledermann 12539.* Not seen.

28. **CYATHEA ALBIDULA Domin.**

C. albidula DOMIN, op. cit., p. 89.
Alsophila hunsteiniana BRAUSE, Engler's Jahrb. **56** (1920) 65.

Sepik region, altitude 1,350 meters, *Ledermann 11099, 11072, 11198.* Not seen.

29. **CYATHEA MACGILLIVRAYI (Baker) Domin.**

C. Macgillivrayi (Baker) DOMIN, Pterid. (1929) 263.
Alsophila Macgillivrayi BAKER, Syn. Fil. (1874) 458.

Louisiade Archipelago, *Macgillivray.* Not seen.

30. **CYATHEA GEPPIANA Domin.**

C. geppiana DOMIN, Acta Bot. Bohem. **9** (1930) 118.
Alsophila straminea GEPP in Gibbs, Dutch N. W. New Guinea (1917) 192.

Humboldt Bay, altitude 500 feet, *Gibbs 6256.* Not seen.

31. **CYATHEA WILKESIANA Domin.**

C. wilkesiana DOMIN, Acta Bot. Bohem. **9** (1930) 171.
Alsophila samoensis BRACK., U. S. Expl. Exped. **16** (1854) 287, pl. 40, fig. 1.

Louisiade Archipelago, *Macgillivray,* fide Baker,[5]—"I have seen no authentic specimen of this; but some of my specimens from the Louisiade sufficiently accord with the description and figure."

32. **CYATHEA SCABERULA (Christ) Domin.**

C. scaberula (Christ) DOMIN, Pterid. (1929) 263.
Alsophila scaberula CHRIST in Schum. & Laut., Fl. deut. Schutz-Geb. (1901) 110. Not seen.

33. **ALSOPHILA ARFAKENSIS Gepp.**

Alsophila arfakensis GEPP. in Gibbs, Dutch N. W. New Guinea (1917) 70.

Arfak Mts., altitude 7,000 to 8,500 feet, *Gibbs 5990.* Not seen.

34. **CYATHEA ORDINATA Copel. nom. nov.**

Alsophila tomentosa Hooker var. *novo-guineensis* ROS., Fedde's Repert. **5** (1908) 34.

[5] Syn. Fil. (1874) 39.

Mt. Gelu, altitude 1,700 meters, *Werner* (1907) *71*. Isotype in Herb. Univ. Calif.

Too different from *C. tomentosa* (Blume) Zoll. to be regarded as a variety; moreover, not, in my opinion, very intimately related to that species. It is nowhere quite tripinnate; the secondary rachises are less spinulose; the costæ of the pinnules are more scaly, and bear near their bases conspicuous pale lanceolate paleæ of a type wanting on the Java plant. It is more nearly related to *C. magna*. *Brass 4063* and *4966*, Mt. Tafa, altitude 2,400 meters, match the isotype perfectly. The base of the stipe is immersed in pale scales 1–3 cm long, some of them fuscous-tipped.

35. CYATHEA MAGNA Copeland. Plate 7.

Cyathea magna COPELAND, U. C. Publ. Bot. 18 (1942) 218.

Arbor, trunco teste Brassio 8 m alto, 25 cm crasso; stipite 80–90 cm longo, 1.5 cm crasso, purpureo-fusco, spinis 4 mm altis paleas lanceolatas fuscas 1 cm longas ferentibus horrido; lamina teste Brassio fere 3 m longa, rhachi laete castanea, spinis minoribus horridula, paleis aurantiacis ciliatis deciduis vestita, sparse furfuracea; pinna maxima 85 cm longa, 25 cm lata, brevipedicellata, profunde bipinnatifida; rhachi superne sulcata pilis minutis nigris et crinitis et rectis vestita, inferne et lateraliter verrucosa furfuracea tum demum glabrescente; pinnulis sessilibus, 14 cm longis, fere 2 cm latis, brevi-acuminatis, coriaceis, costa superne pilis minutis deorsum plerisque fuscis sursum cinereis, inferne paleis variis ciliatis,—et deorsum castaneis lanceolatis et ubique cinereis laceris, et squamulis amorphis,—vestita; segmentis contiguis, 8 mm longis 3 mm latis, rotundatis, obscure denticulatis, margine modo deflexis, superne atroviridibus glabrescentibus, inferne costula squamulis laceris pallidis onusta, alibi pilis albidis brevibus sparsis; soris usque ad 13-paribus, constularibus, indusiis carentibus.

DUTCH NEW GUINEA: Bele River, altitude 2,250 meters, *Brass No. 11278*. "Fagaceous forest; plentiful on very steep slope...; interrupted white line on sides of stipe and rachis,"—this not visible in the herbarium.

A relative of *C. atrox* and *C. ordinata*, much more ample than either, with few dark basal paleæ instead of the pale ones of the latter and many dark ones of the former, the pinnules much more scaly than those of *C. atrox*.

36. CYATHEA HORRIDULA Copeland. Plate 8.

Cyathea horridula COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Arbor, trunco teste Brassio 3 m alto gracile; stipite 40 cm longo, 8 mm crasso, deorsum paleis deciduis stramineis 1.5 cm longis 1 mm latis apice minute obscure ciliatis vestito, ubique spinulis 0.5–1.0 mm longis muricato, sparse sordide furfuraceo; lamina speciminis imperfecta, apice 20 cm longa bipinnatifida acuminata; rhachi brunnea minutissime muriculata; pinna infima arcte recurva 25 cm longa 8 cm lata breviter (8 mm) pedicellata; pinna mediale 45 cm longa, 10–11 cm lata, acuminata, subsessile, vix bipinnata, rhachi superne atro-fusco-tomentosa, inferne squamulis minutis bullatis et amorphis aliisque paucis filiformibus 3 mm longis sparse vestita; pinnulis contiguis, sessilibus, 5.5 cm longis 13 mm latis, acutis, profunde pinnatifidis; segmentis paucis infimis adnatis non confluentibus, papyraceis, superne obscuris costis sparse tomentellis aliter glabris, inferne pallidioribus costis deorsum paleis stramineis 2–5 mm longis basi 1 mm latis deinde contractis cum squamulis bullatis et amorphis intermedialibusque mixtis vestitis; segmentis 3 mm latis, oblique obtusis, apice denticulatis alibi subserrulatis, costulis inferne squamulis paucis deciduis sparsis; pinnulis fertilibus paullo contractis, soris costularibus, indusiis nullis.

DUTCH NEW GUINEA: 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1,700 meters, *Brass No. 12043*, in undergrowth of rain-forest gulley.

A rather characterless species, with conspicuous paleæ on the basal half of the costæ and nowhere else, with only a few remaining on the rather densely short-muricate stipe.

37. CYATHEA SCABRISETA Copeland.

C. scabriseta COPEL., Phil. Jour. Sci. 9 (1914) Bot. 2.

Papua, type locality unknown, *King 444;* Lower Mori River, *Brass 1570.*

38. CYATHEA BRASSII Copeland.

C. Brassii COPEL., Jour. Arnold Arb. 10 (1929) 175.

Eastern Division: Aisa River, *Brass 1421.* Possibly not distinct from *C. scabriseta.*

39. CYATHEA SCABERULIPES (v A. v. R.) Domin.

C. scaberulipes (v. A. v. R.) DOMIN, Acta Bot. Bohem. 9 (1930) 174.
Alsophila scaberulipes v. A. v. R., Nova Guinea 14 (1924) 2.

DUTCH NEW GUINEA: Prauwenbivak, altitude 60 to 90 meters, *Lam 868*, isotype in Herb. Univ. Calif. I have very nearly the same plant from the Solomon Islands, *Brass 3124*. Var. *ciliolata* v. A. v. R.[6] is a more robust individual, also represented by isotype in Herb. Univ. Calif.

40. CYATHEA PILULIFERA Copeland. Plate 9.

Cyathea pilulifera COPELAND, U. C. Publ. Bot. 18 (1942) 219.

C. contaminanti affinis, rhachi brunneo-purpurea, fronde minore, et venulis inferne pilis minutis multis ornatis diversa; trunco breve; stipite 50 cm longo, paleis stramineo-albis flaccidis 1–1.5 cm longis lanceolatis attenuatis setis deciduis pallidis et obscuris ciliatis per mediam longitudinem (stipitis) vestito, spinis 3–5 mm longis acutis densis munito, sursum rhachique glabrescentibus purpurascentibus spinis minoribus aculeatis; lamina ut videtur vix 1 m longa, abrupte acuminata, basi truncata, vix tripinnata, rhachibus superne atro-fusco-tomentosis; pinna infima recurva longius (6 cm) pedicellata, 16 cm longa 14 cm lata; pinna sequente maxima, brevius (2 cm) pedicellata, 32 cm longa vix 14 cm lata, acuminata, pinnulis 7 cm longis, 12 mm latis, acuminatis, plerisque sessilibus, profunde sed nullibi ad costam pinnatifidis, superne fusco-viridibus, inferne olivaceis, costis glabrescentibus; segmentis contiguis, 2.5 mm latis, falcato-obtusis, coriaceis, costulis deorsum squamulis minutis stramineis bullatis ornatis, sursum venisque pilis multis albidis minutis vestitis; soris in framedialibus, parvis, indusiis carentibus.

DUTCH NEW GUINEA: Bele River, altitude 2,200 meters (?), *Brass No. 11492*. "Very abundant in young second-growth forest, in old garden lands, and often preceding woody growths after the weed stage; stem very short or obsolete; fronds spreading, glaucous underneath:" in the herbarium, they are somewhat pale, but not glaucous.

"*Alsophila glauca* var. *squamulata*" Ros. has larger hairs as well as scales on the costulæ. It is much larger, tripinnate, its rachises brown, not reddish. *Cyathea aeneifolia* has deciduously short-hairy veins.

40a. CYATHEA SAPARUENSIS v. A. v. R.

Cyathea saparuensis v. A. v. R—*Alsophila saparuensis* v. A. v. R.[7]—is reported from Dutch New Guinea by Ridley. It is an

[6] Nova Guinea 14 (1924) 2.
[7] Bull. Dept. Agric. Ind. Neerl. 18 (1908) 2.

imperfectly known species, doubtfully represented by a living plant in Buitenzorg.

41. CYATHEA AENEIFOLIA (v. A. v. R.) Domin.

C. aeneifolia (v. A. v. R.) DOMIN, Acta Bot. Bohem. 9 (1930) 174.
Alsophila aeneifolia v. A. v. R., Nova Guinea 14 (1924) 3.

Doorman-top, altitude 3,240 meters, *Lam 1751*. Not seen.

Var. *subglauca* v. A. v. R.,[8] *Lam 1805*, is a larger plant, with smaller spines and smaller pinnules.

42. CYATHEA GREGARIA (Brause) Domin.

C. gregaria (Brause) DOMIN, op. cit., p. 120.
Alsophila gregaria BRAUSE, Engler's Jahrb. 56 (1920) 68.

Sepik region, altitude 2,070 meters, *Ledermann 11627, 12056*. Not seen.

43. CYATHEA TENUICAULIS Domin.

C. tenuicaulis DOMIN, op. cit., p. 165.
Alsophila tenuis BRAUSE, Enger's Jahrb. 56 (1920) 71.

Sepik region, altitude 300 to 400 meters, *Ledermann 7498*. Not seen; but I have *Carr 13363* and *14542*, from Boridi, altitude 5,000 feet, determined by Alston, probably by comparison with the type. They are not nearly related to *C. contaminans*.

44. CYATHEA BRAUSEANA Domin.

C. brauseana DOMIN, Pterid. (1929) 262.
Alsophila Hieronymi BRAUSE, Engler's Jahrb. 49 (1912) 14.

Kani Mts., altitude 600 meters, *Schlechter 17635*. Not seen. "Ist eine für sich allein stehende Art ohne Annäherung an andere bekannte Formen."

45. CYATHEA WENGIENSIS (Brause) Domin.

C. wengiensis (Brause) DOMIN, Pterid. (1929) 263.
Alsophila wengiensis BRAUSE, Engler's Jahrb. 49 (1912) 13, fig. 1 C.

KAISER-WILHELMSLAND: Near Wengi, altitude 500 meters, *Schlechter 16100*; isotype in Herb. Univ. Calif. Well characterized by the many small median sori, forming a row around each segment, wanting near the costa.

46. CYATHEA DIELSII (Brause) Domin.

C. Dielsii (Brause) DOMIN, Acta Bot. Bohem. 9 (1930) 111.
Alsophila Dielsii BRAUSE, Engler's Jahrb. 56 (1920) 67.

Sepik region, altitude 2,070 meters, *Ledermann 11627, 12056*. Not seen; but, judging by description, *Brass 4549*, Murray Pass, altitude 2,840 meters, may well be this species.

[8] Ibid.

47. CYATHEA MELANACANTHA Copeland. Plate 10.

Cyathea melanacantha COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Alsophila gregis C. contaminantis; trunco teste Brassio 1.5 m alto; stipite 60 cm longo, basi 3 cm sursum 7 mm crasso, paleis 1 cm longis angustis brevi-aciculatis breviter et decidue ciliatis atrocastaneis nitidis deorsum dense sursum sparse vestito, spinis nigris validis acutis deorsum 6 mm longis sursum minoribus perhorrido; fronde speciminis imperfecta, verosimiliter 1.5 m longa, abrupte acuminata, vix tripinnata, rhachi fulvo-fusca, spinulosa, minute furfuracea, ad pedes pinnarum paleis stramineis integris angustis 1 cm longis ornata (iisdem alibi verosimiliter dejectis) ; pinna mediale 40 cm longa 16 cm lata, abrupte acuminata, breviter (12 mm) pedicellata, rhachi muricata minute furfuracea; pinnulis sessilibus, 9 cm longis, 16 mm latis, acutis, inferioribus ad basin tantum pinnatis alibi fere ad costas pinnatifidis, costis superne setuliferis, inferne paleis minutis stramineis et bullatis apiculatis et lanceolatis planis et filiformibus vestitis; segmentis coriaceis, subfalcatis, obtusis, obscure serrulatis, superne atroviridibus subnudis, inferne subglaucis, squamulis variis pallidis ca. 0.5 mm longis ubique sat dense ornatis; soris ca. 8-paribus, contiguis, fulvis, indusiis omnino carentibus.

DUTCH NEW GUINEA: Lake Habbema, altitude 3,225 meters, *Brass No. 9311*. "Occasional in forest edges; fronds few, glaucous beneath, lower and medial pinnae curved back towards stipes."

Forms referred to *C. contaminans* as varieties bear a variety of squamules and hairs on the veins, none as copiously as this species. The sharply diagnostic character is the mass of short brownish-black paleæ on the lower part of the stipe; on *C. contaminans*, these are pale, and longer. *King 215*, from British Papua, in open country, is an incomplete specimen, possibly of this species.

48. CYATHEA EXTENSA (Forster) Swartz.

Ledermann 8595, 6577, 7010, fide Brause. Long accredited to New Guinea, whence I know no specimen. The species is best known as a plant of Fiji, but that cannot be its type locality.

49. CYATHEA INTERMEDIA (Mett.) Copeland.

C. intermedia (Mett.) COPEL., Univ. Calif. Publ. Bot. 16 (1929) 357.
Alsophila intermedia METT., Ann. Sc. Nat. IV 15 (1861) 83.

This is a species of New Caledonia, reported from New Guinea, but not known to me there.

50. CYATHEA ATROX C. Chr.

C. atrox C. CHR., Brittonia 2 (1937) 275.

Lake Habbema, altitude 3,225 meters, *Brass 9444*. "Few trees in moister and denser thickets of peaty ridges; 3–5 m high, 11 cm diam.; leaves 19, about 1.5 m long, 65 cm broad, forming a spreading crown; leaves in vertical rows; stipes not appressed, not persistent." Previous collections are the type, *Brass 4596*, from Murray Pass, altitude 2,840 meters, and *Brass 4410*, from Mt. Albert Edward, altitude 3,680 meters. Characterized by dark basal paleæ, many coarse black-tipped spines on the stipe, and abundant various ferruginous paleæ beneath the frond. The Lake Habbema specimen conforms except for weak whitish paleæ on the upper side of the upper part of the stipe and lower part of the rachis; and it is not quite so spiny. The dark-chestnut basal scales are the same.

51. CYATHEA CONTAMINANS (Wall.) Copeland.

C. contaminans (Wall.) COPEL., Phil. Jour. Sci. 4 (1909) Bot. 60.
Alsophila glauca (Blume) J. Sm.

This is commonly construed as a most variable species. We have without a varietal name *Schlechter 16624*, the costulæ sparingly hairy beneath, segments 5 mm wide. Var. *setulosa* is represented by *Lam 1292*, Doorman River, altitude 200 meters; *Brass 13647* Idenburg River, altitude 850 meters, is the same. *Brass 5488*, Mafulu, altitude 1,250 meters, is similar but less hairy. Var. *trichopoda* Ros.[9] is based on *Bamler* (1914) *101* (of which our specimen, from Dr. Rosenstock, is labeled "v. squamulata Ros. n. v."). *Werner* (1907) *81*, from Mt. Gelu, is labeled "v. eriosora Ros. n. v."

Equally various forms are referred to this species in other lands. Construing it thus broadly, I am unable to distinguish:

CYATHEA ARUENSIS Domin.

C. aruensis DOMIN, Pterid. (1929) 262.
Alsophila polyphlebia BAKER, Jour. Linn. Soc. 15 (1876) 104, from Aru Island.

CYATHEA NAUMANNII (Kuhn) Domin.

C. Naumannii (Kuhn) DOMIN, Pterid. (1929) 263.
Alsophila Naumannii KUHN, Forschungsr. Gazelle 4 (1889) 13; of which, according to the labels, we have *Schlechter 17532* and *Keysser* (1913) *173*, which are not alike; and *Carr 13217*, named with doubt.

[9] Hedw. 56 (1915) 349.

CYATHEA CURVIPINNULA C. Chr.

C. curvipinnula C. CHR., Brittonia 2 (1937) 276.

It is not my intent to reduce these three species, but merely to state that they do not appear to be more distinct than the forms elsewhere treated as varieties of *C. contaminans*.

52. **CYATHEA FUGAX v. A. v. R.**

C. fugax v. A. v. R., Bull. Jard. Bot. Buit. 7 (1912) 8.

"Papua, in open country," *King 215*.

The indusium is fugacious indeed; but this can be distinguished from *C. contaminans* by scaliness also.

53. **CYATHEA TRUNCATA (Brack.) Copeland.**

C. truncata (Brack.) COPEL., Phil. Jour. Sci. 4 (1909) Bot 39.
Var. *nivea* CHRIST in Schum. & Laut., Fl. deut. Schutz-Geb. Nachtr. (1905) 36.

Only the variety is accredited to New Guinea; it is unknown to me, and I mistrust its specific identity with the Polynesian species.

54. **CYATHEA EMINENS Domin.**

C. eminens DOMIN, Pterid. (1929) 262.
Alsophila concinna BAKER, Syn. Fil. (1874) 459.

Louisiade Archipelago, *Macgillivray*. Not seen.

55. **CYATHEA ATROPURPUREA Copeland.**

C. atropurpurea COPEL., Phil. Jour. Sci. 3 (1909) 354; 4 (1909) 36, pl. 18.

This is a Philippine species. Its report from New Guinea is probably an error, originating in Christensen, Index Suppl. I (1913) 4.

56. **CYATHEA ATRISPORA Domin.**

C. atrispora DOMIN, Acta Bot. Bohem. 9 (1930) 95.
Alsophila dryopteroidea BRAUSE, Engler's Jahrb. 56 (1920) 70.

Sepik region, altitude 2,070 meters, *Ledermann 1897*. In spite of Brause's confidence that he detected a complete annulus, this may still be suspected of being a *Dryopteris*.

57. **CYATHEA ASCENDENS Domin.**

C. ascendens DOMIN, op. cit., p. 94.
Alsophila Rosenstockii BRAUSE, Engler's Jahrb. 56 (1920) 63.

Sepik region, altitude 1,000 meters, *Ledermann 9963;* Etappenberg, altitude 850 meters, *Ledermann 9361*. Not seen. Frond not quite bipinnate. This also looks like a *Dryopteris*, but I credit Brause's assignment to "Alsophila."

58. CYATHEA SCANDENS (Brause) Domin.

C. scandens (Brause) DOMIN, op. cit., p. 156.
Alsophila scandens BRAUSE, Engler's Jahrb. 56 (1920) 77.

Sepik region, altitude 1,000 meters, *Ledermann 9885*. Related to *C. biformis*, which also is scandent.

59. CYATHEA BIFORMIS (Ros.) Copeland.

C. biformis (Ros.) COPEL., Phil. Jour. Sci. 6 (1911) Bot. 423.

Brass 8947, Cyclops Mountains, altitude 575 meters; *13318*, *12289*, Idenburg River region, altitude 900 and 1,800 meters. All scandent, as is true also of the type collection, *King 57*, from the Gira gold field. Well characterized by black and purplish-black axes, shiny, dark-brown linear paleæ on the stipe, and dimorphous fronds, the sterile pinnules serrulate to crenate, the fertile pinnules pinnate. Beyond this, variable. *Nos. 8947* and *12289* are like the type in having dwarf-pinnæ at the base of the stipe, but *No. 13318* is without these. *No. 13318* is like the type in having conspicuous paleæ on the lower part of the rachis; *Nos. 8947* and *12289* have them only at their base. The pinnules vary in shape and in nakedness; and the dimorphism is imperfect. Pinnate fronds of juvenile terrestrial plants accompany *Nos. 8947* and *12289*. Brause [10] cites five collections by Ledermann.

As to *Cyathea Gibbsiae* Copel.,[11] *Polybotrya arfakensis* Gepp, *Thysanosoria arfakensis* v. A. v. R., I still have not seen it, nor had Brause, who reduced it to *C. biformis*. *Cyathea biformis* is more variable than I have realized in the past, and is accordingly more likely to include another variant.

60. CYATHEA SCHLECHTERI (Brause) Domin.

C. Schlechteri (Brause) DOMIN, Pterid. (1929) 263.
Alsophila Schlechteri BRAUSE, Engler's Jahrb. 49 (1912) 15, fig. 1 D.

Kani Mts., altitude 1,000 meters, *Schlechter 17140*. Isotype in Herb. Univ. Calif.

61. CYATHEA DIMORPHOPHYLLA Domin.

C. dimorphophylla DOMIN, Acta Bot. Bohem. 9 (1930) 111.
Alsophila Ledermanni BRAUSE, Engler's Jahrb. 56 (1920) 76.

Sepik region, altitude 850 meters, *Ledermann 9275, 9568*. Not seen.

62. CYATHEA BRUNNEA (Brause) Domin.

C. brunnea (Brause) DOMIN, op. cit., p. 101.
Alsophila brunnea BRAUSE, Engler's Jahrb. 56 (1920) 73.

[10] Engler's Jahrb. 56 (1920) 74.
[11] Phil. Jour. Sci. 33 (1920) 129.

Sepik region, *Ledermann 9871,* altitude 1,000 meters; *12113,* altitude 2,070 meters. Not seen.

63. CYATHEA GRACILLIMA Copeland. Plate 11.

Cyathea gracillima COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Arbor, trunco 1.5–3 m alto, 1.5 cm crasso, sursum basibus muricatis stipitum aspero; stipite ca. 25 cm. longo, vix 5 mm crasso, basi trunco appresso, deinde patente, cinnamomeo, deorsum dense sursum sparsius spinulis asperato, basi paleis castaneis 1 cm longis basi vix 1 mm latis integris sursum denticulatis apice acicularibus vestito, alibi glabrescente; lamina 90 cm longa, 45 cm lata, acuminata, profunde tripinnatifida; rhachi deorsum spinulis paucis minutis praedita, alibi molle, superne sulcata sordide furfuracea, inferne nuda; pinnis medialibus 25 cm longis, 10 cm latis, acuminatis, pedicellatis, infimis paullo minoribus deflexis; pinnulis brevissime stipitulatis, breviter acuminatis, papyraceis, superne costis pilis minutis inflexis vestitis aliter glabris atro-viridibus, inferne pallidioribus costis et costulis squamulis minutis pallidis lanceolatis et ovatis subbullatis sparsis, sterilibus usque ad 5.5 cm longis 13 mm latis, segmentis 2.5–3 mm latis, apice rotundatis, obscure crenulatis, ala angusta confluentibus; pinnulis fertilibus paullo minoribus, segmentis angustioribus, inferne soris confluentibus omnino obtectis, indusiis nullis.

DUTCH NEW GUINEA: Bernhard Camp, Idenburg River, *Brass No. 12824,* type, altitude 1,200 meters. "Very slender tree-fern, 1.5–2 m high; bulbils frequent on stem; leaves few, flat-spreading, only one fertile. Locally common on ridges in the rain forest." *No. 13489,* altitude 850 meters, "plentiful on river flats; very slender tree-fern 2–3 m high."

The contraction of the fertile pinnæ is fairly conspicuous. On *No. 12824,* the lower part of the frond is fertile, the upper part sterile and more ample. *No. 13489* has a frond fertile throughout, and similarly contracted.

64. CYATHEA OLIVACEA (Brause) Domin.

C. olivacea (Brause) DOMIN, Acta Bot. Bohem. 9 (1930) 143.

Alsophila olivacea BRAUSE, Engler's Jahrb. 56 (1920) 74.

Sepik region, altitude 2,070 meters, *Ledermann 12092, 12096.* Not seen.

65. CYATHEA MELANOCLADA Domin.

C. melanoclada DOMIN, op. cit., p. 174.

Alsophila melanocaulos v. A. v. R., Nova Guinea 14 (1924) 1.

Doorman-top, altitude 1,420 meters, *Lam 1567;* isotype in Herb. Univ. Calif.; Cyclops Mts., altitude 500 meters, *Brass 8946;*

Idenburg River, altitude 1,800 meters, *Brass 12288;* altitude 1,200 meters, *No. 12822.* The field notes on the last two collections emphasize the deciduous character of the fertile lower pinnæ.

The most similar species known to me is *C. Hornei* (Baker) Copel., of Fiji, which has stalked sterile pinnules, pinnate only at the base; *C. Schlechteri* may be still more like this. Judging by the descriptions, *C. brunnea* and *C. dimorphophylla* are nowhere quite tripinnate; the pinnules of *C. olivacea* are pinnate near the base; those of *C. melanoclada*, pinnate throughout.

66. CYATHEA HUNSTEINIANA Brause.

C. hunsteiniana BRAUSE, Engler's Jahrb. 56 (1920) 58.

Sepik region, altitude 1,300 meters, *Ledermann 11139;* altitude 2,070 meters, *Ledermann 11832,* and (var. *acuminata* Brause, *ibid.*) *12186;* altitude 1,400 to 1,500 meters, *Ledermann 12742.* Not seen.

67. CYATHEA LEDERMANNI Brause.

C. Ledermanni BRAUSE, Engler's Jahrb. 56 (1920) 56.

Sepik region, altitude 200 to 400 meters, *Ledermann 9651;* Lordberg, altitude 1,000 meters, *Ledermann 9882.* Not seen; but *Brass 13092,* Idenburg River, altitude 900 meters, conforms to the description.

68. CYATHEA MICROPHYLLOIDES Ros.

C. microphylloides ROS., Fedde's Repert. 12 (1913) 164.

Bolan Mts., altitude 2,400 to 3,000 m, *Keysser* (1912) *B. 71.* Not seen.

69. CYATHEA PERPELVIGERA v. A. v. R.

C. perpelvigera v. A. v. R., Nova Guinea 14 (1924) 11.

Doorman-top, altitude 1,400 to 2,500 meters, *Lam 1441;* isotype in Herb. Univ. Calif.; *Lam 1947;* Idenburg River, altitude 1,800 meters, *Brass 11896,* very abundant in absence of woody undergrowth. Trunk 2.5 m high, 1.5–2 cm in diameter. Remarkable for its slender trunk and finely dissected foliage.

70. CYATHEA PERANEMIFORMIS C. Chr.

C. peranemiformis C. CHR., Brittonia 2 (1937) 277.

Mt. Tafa, altitude 2,400 meters, *Brass 4990.*

71. CYATHEA PULCHERRIMA Copeland. Plate 12.

Cyathea pulcherrima COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Arbor gracillima, trunco teste Brassio usque ad 6 m alto, 3 cm crasso; stipite 50 cm longo, rhachique paleis castaneo-

atris setiformibus hispidis 2 cm longis dense vestitis, sursum inferne paleis plerisque dejectis dense muricatis; lamina 1 m longa, brevi-acuminata, late ovata; pinna infima 35 cm longa, subdeflexa, breviter (1 cm) pedicellata; pinna mediale subsessile, ca. 50 cm longa, 18 cm lata, tripinnatifida, rhachi setis minoribus pallescentibus sparsis vestita; pinnulis[i] sessilibus, vix contiguis, 9.5 cm longis, 15 mm latis, acutis, rhachillis costisque et sparsissime venis setis pallidis ca. 1 mm longis vestitis; pinnulis[ii] 3 mm latis, obtusis, basi ad costas pinnatis alibi profunde pinnatifidis, oblique adnatis et (infimis exceptis) decurrenti-adnatis, herbaceis, viridibus, segmentis ultimis plerisque apice late bidentatis; soris prope basin segmenti solitariis, indusio tenue persistente.

DUTCH NEW GUINEA: Idenburg River, altitude 575 meters, *Brass No. 8940*, type, "abundant in sheltered moist hollows in tall forest;" also, *No. 12961*, altitude 1,100 meters. "Common on crests of ridges in rain forest; stem 4.5 m high, 5 cm diam. under the leaves; fronds 7, flat-spreading, 2.9 m long including the 1 m long stipes."

In texture and dissection, much like *C. alata* (Fournier) Copel., of New Caledonia.

72. CYATHEA LEPIDOCLADA (Christ) Domin.

C. lepidoclada (Christ) DOMIN, Acta Bot. Bohem. 9 (1930) 130.
Alsophila lepidoclada CHRIST in Schum. & Laut. Fl. deut. Schutz-Geb. Nachtr. (1905) 37.

Brass 13357, Idenburg River, altitude 850 meters, conforms to the description except for being larger throughout. The stipe is 20 cm long; its paleæ 15 by 3–4 mm, the margin entire or erose; lamina 1.5 m long, nearly 40 cm wide; larger pinnæ 22 cm long, 3.5–4 cm wide near the base, the lowest basiscopic pinnule distinctly the largest; lowest secondary pinnules dilated in the middle, contracted at the base, the others decurrent-confluent. I can find no trace of an indusium; it is evident, and (in age) smoothly truncate in *C. peranemiformis* and *C. perpelvigera*, and so described in *C. hunsteiniana*.

73. CYATHEA PARVA Copeland. Plate 13.

Cyathea parva COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Arbor parva, trunco teste Brassio 1.5 m alto, apice 3.5 cm crasso; stipite 10 cm longo, basi incrassato paleis 1–1.5 cm longis basi 1 mm latis stramineis linea mediale sursum interdum castanea aciculari-extensa vestito, sursum 3 mm crasso glabrescente, minute dense muriculato; rhachi brunnea, sursum

laeve, paleis paucis linearibus usque ad 5 mm longis pallidis vix persistentibus ornata, minutissime furfuracea; lamina 55 cm longa, 32 cm lata, acuminata, vix tripinnata; pinnis infimis 6 cm longis, recurvis, pinnatis; medialibus 17 cm longis, 5 cm latis, acuminatis, subsessilibus, rhachibus superne cinnamomeo-tomentosis, inferne paleis stramineis usque ad 5 mm longis et 1 mm latis aliisque angustioribus et filiformibus vestitis; pinnulis sterilibus 6 mm fertilibus 5 mm latis, sessilibus, acutis vel obtusis, vix ad costas pinnatifidis, papyraceis, superne fusco-viridibus costis inconspicue pilulosis, inferne brunneo-viridibus costis deorsum squamulis stramineis 1.5–2 mm longis ovatis subbullatis vestitis, venulis inconspicuis simplicibus, soris 3–4-paribus, contiguis, costularibus, parvis, indusio falso squamulis nonnullis basalibus laceris constituto.

DUTCH NEW GUINEA: 15 kilometers southwest of Bernhard Camp, Idenburg River, altitude 1,750 meters, *Brass No. 12197*. "Undergrowth of a rain-forest gulley; leaves 4, 90 cm long."

Probably related to *C. lepidoclada;* the paleæ on the minor axes more suggestive of *C. albidosquamata;* peculiar in the muriculate stipe.

74. CYATHEA KLOSSII Ridley.

C. Klossii RIDLEY, Trans. Linn. Soc. II 9 (1916) 251.

Trail to Mt. Carstensz, altitude 1,100 to 2,500 feet. Not seen.

75. CYATHEA PAPUANA (Ridley) v. A. v. R.

C. papuana (Ridley) v. A. v. R., Malayan Ferns Suppl. (1917) 487.
Alsophila papuana RIDLEY, Trans. Linn. Soc. II 9 (1916) 252.

Trail to Mt. Carstensz, altitude 2,500 feet, *Boden-Kloss;* Isuarawa, altitude 5,000 feet, *Carr 15545, 15720*.

76. CYATHEA KEYSSERI Ros.

C. Keysseri ROS., Fedde's Repert. 12 (1913) 164.

Bolan Mts., altitude 3,400 to 3,800 meters, *Keysser* (1912) *B. 32*: *Clemens*, s. n., "common at 12,000 feet and above on Sarawaket,—meadow margins."

See notes under the following species.

77. CYATHEA CHEILANTHOIDES Copeland. Plate 14.

Cyathea cheilanthoides COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Arbor, trunco breviusculo; stipite subnullo basique stipitis paleis 6 cm longis basi 2 mm latis aciculari-attenuatis integris rigidis vix tortis et haud crinitis castaneis nitidis pallide (ferrugineo-) marginatis immersis; lamina 75 cm longa, 20 cm lata,

subacuta, tripinnata; rhachi fusca, glabrescente, deorsum aerophoris paucis leviter elevatis subrotundis praedita, aliter laeve et molle; pinnis supramedialibus maximis, 13 cm longis, 3.5 cm latis, erecto-patentibus, imbricatis, subsessilibus, abrupte acutis, basi truncatis, rhachillis purpureo-fuscis, superne paleis albidis anguste linearibus appressis vestitis, inferne glabrescentibus; pinnulis^{i} 3 cm longis, 3 mm latis, sessilibus, infimis infra rhachin deflexis caeteris plerisque erecto-patentibus, rhachillis superne nudis, inferne squamulis paucis pallidis deciduis praeditis; pinnulis^{ii} bullatis vel cucullatis, plerisque semi-globosis, inferioribus triangulari-oblongis, coriaceis, superne glabris fuscis, inferne squamulas paucas pallidas fibrillasque includentibus; soris ad pinnulam quamque orbicularem plerumque 2 vel 3, ad pinnulas longiores usque ad 5, indusio brunneo persistente; pinnis inferioribus minoribus, subremotis, etenim e paleis basalibus emergentibus, 6 cm longis, pinnulis^{ii} cucullatis sterilibus.

DUTCH NEW GUINEA: Lake Habbema, altitude 3,225 meters, *Brass No. 9283*. "Associated with low shrubs on well drained grassy ridges; gregarious; very striking feature of vegetation, 1 to over 3 m high; material from old plant, stem 1 m high, 17 cm diam. at base, 24 cm diam. under crown; fronds 29, glaucous beneath, rachis glaucous."

This is another species of the group of *C. Macgregori*, *C. Keysseri* and *C. gleichenioides*. *Cyathea imbricata* is only approximately one of this group, having merely convex segments instead of strongly bullate secondary pinnules, and broad, dark, shorter basal paleæ, which do not form a dense mass. I have complete frond of *C. Macgregori*, det. C. Chr., *C. gleichenioides* and *C. imbricata,* isotypes, and the upper part of an isotype of *C. Keysseri;* such material of *Cyathea* is a luxury. As to form and dissection of the frond of *C. Keysseri,* I depend upon the description; our specimen does not show them, and they are apparently distinctive features; the *costis primariis . . . asperulis* are also diagnostic, and conspicuous. *Cyathea cheilanthoides* is by far the most naked of the four, distinguished further by the absence of any stipe above the pinnæ at the very base, and by the stiffer, straighter, pale-marginate basal paleæ. The paleæ of *C. Macgregori* are softer and much twisted, those of *C. gleichenioides* still softer and almost crinite, and both are practically nonmarginate. Both of these have more reduced basal pinnæ (Christensen is in error as to *C. Macgregori,* and it is probably

not constant), with some stipe above them, below the pinnæ of the lamina proper.

78. CYATHEA MACGREGORI F. v. Mueller.

C. Macgregori F. v. MUELLER [Tr. Royal Soc. Victoria 1 (1889) 40] Jour. of Bot. 28 (1890) 104; CHRISTENSEN, Brittonia 2 (1937) 280.

Mt. Knutsford, *MacGregor;* Mt. Albert Edward, altitude 3,680 m, *Brass 4285, 4351.* Known to me by Brass's collections, fully described by Christensen. Reported also from the trail to Mt. Carstensz, altitude 3,900 feet, by Ridley.

79. CYATHEA GLEICHENIOIDES C. Chr.

C. gleichenioides C. CHR., Brittonia 2 (1937) 281.

Murray Pass, altitude 2,840 m, *Brass 4595;* Mt. Albert Edward, altitude 3,680 m, *Brass 4265.*

80. CYATHEA IMBRICATA v. A. v. R.

C. imbricata v. A. v. R., Nova Guinea 14 (1924) 11.

Doorman-top, altitude 3,250 m, *Lam 1622,* isotype in Herb. Univ. Calif.; *1729.*

81. CYATHEA ARFAKENSIS Gepp.

C. arfakensis GEPP in Gibbs, Dutch New Guinea (1917) 69.

Angi Lakes, altitude 8,000 feet, *Gibbs 6008.* Not seen.

82. CYATHEA TOMENTOSISSIMA Copeland. Plate 15.

Cyathea tomentosissima COPELAND, U. C. Publ. Bot. 18 (1942) 219.

Arbor, trunco crasso; stipite 30 cm longo, (sicco) 5 mm crasso, basi paleis castaneis nitidis 5 cm longis basi 1 mm latis tortis dense immerso, sursum sub indumento denso fulvo pilorum squamarumque minutarum lacerarum et ciliatarum intertextarum etiam cum paleis albis linearibus 1–2.5 cm longis subintegris et ciliatis mixto brunneo; lamina 35–70 cm longa, 20 cm lata, subacuta, basi modo angustata, subtripinnata, rhachibus ut stipite tomentosis et paleatis paleis sursum minoribus et sparsioribus; pinnis infimis 5–8 cm, medialibus 14 cm longis, 5 cm latis, acutis, subsessilibus basi obliquis; pinnulis[i] majoribus 3 cm longis, 7 mm latis, acutis, sessilibus, rhachillis superne pilis et squamulis amorphis crinitis albis non densis ornatis, inferne squamis dissectis stramineis dense occultis; pinnulis[ii] 3 mm longis, vix 1.5 mm latis, obtusis, adnatis, contiguis vix confluentibus, coriaceis, superne pilis minutis crinitis albis sparsis, cucullatis, inferne tomento cinereo completis; venis ca. 7-pari-

bus, simplicibus, superne conspicuis; soris ca. 3-paribus, per tomentum erumpentibus, ferrugineis, indusio non detecto.

DUTCH NEW GUINEA: Lake Habbema, altitude 3,225 meters, *Brass No. 9116,* type; "Material from robust plant with stem 2 m long by 20 cm diameter under the fronds, more slender at base; fronds 42, suberect;" *No. 9113,* same place, "Along streams of open grassland, in drier shrubberies, never in forest. Material from very old tree 2.5 m high, 16 cm diam. below crown; stem cylindrical with vertical rows of deep scars; living fronds 16 in open crown, about 16 dead ones hanging down."

The mass of basal paleæ is like that of *C. Macgregori,* but somewhat brighter. These, the bullate to cucullate pinnules, and the tomentose axes indicate affinity, but *C. tomentosissima* is much more densely felted. And, in the mass of tomentum, I can detect no indusia. The tomentum may well be responsible for their obsolescence.

83. CYATHEA WOODLARKENSIS Copeland.

C. woodlarkensis COPEL., Phil. Jour. Sci. **9** (1914) Bot. 1.

Woodlark Island. *King 383.*

84. CYATHEA RECURVATA (Brause) Domin.

C. recurvata (Brause) DOMIN, Acta Bot. Bohem. **9** (1930) 153.
Alsophila recurvata BRAUSE, Engler's Jahrb. **56** (1920) 61.

Sepik region, altitude 800 meters, *Ledermann 2964.* Not seen. "Steht habituell keiner der bekannten *Alsophila-Arten* nahe."

SPECIES NOT PLACED

C. GAZELLAE (Kuhn) Domin, Pterid. (1929) 262.
Alsophila Gazellae KUHN, Forschungsr. Gazelle **4** (1889) 13.

C. ANGIENSIS (Gepp) Domin, Acta Bot. Bohem. **9** (1930) 91.
Alsophila angiensis GEPP in Gibbs, Dutch N. W. New Guinea (1917) 69.

ILLUSTRATIONS

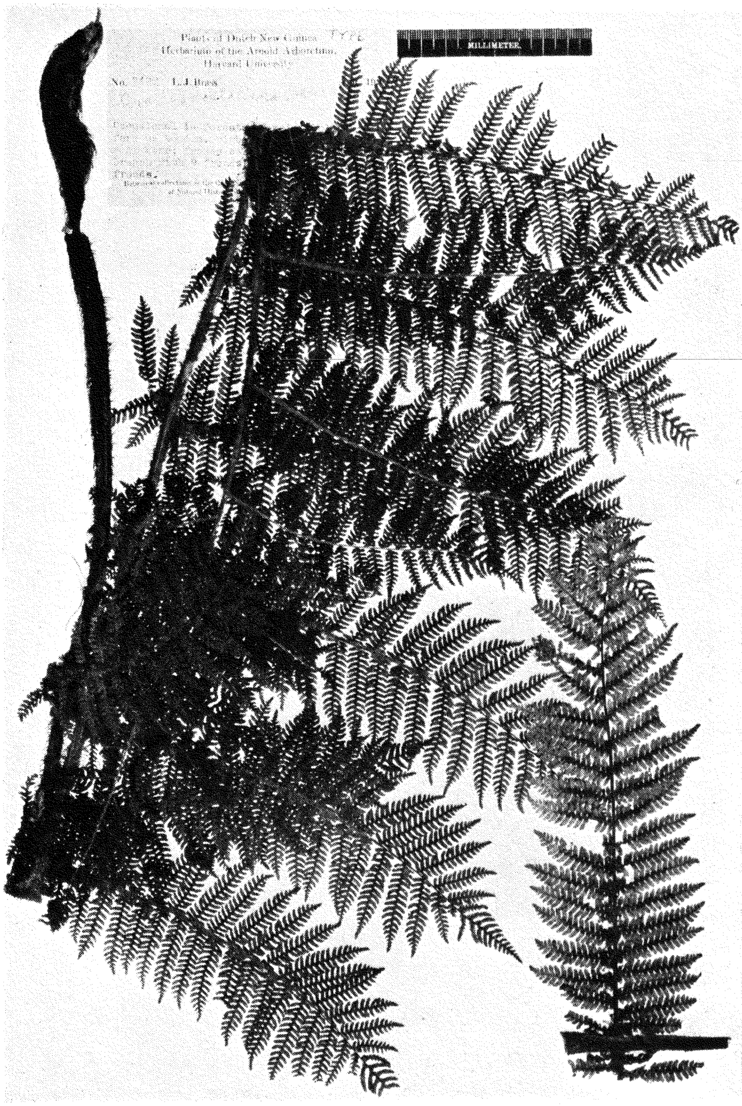

PLATE 1. CYATHEA COSTALISORA COPEL.

PLATE 2. CYATHEA EVERTA COPEL.

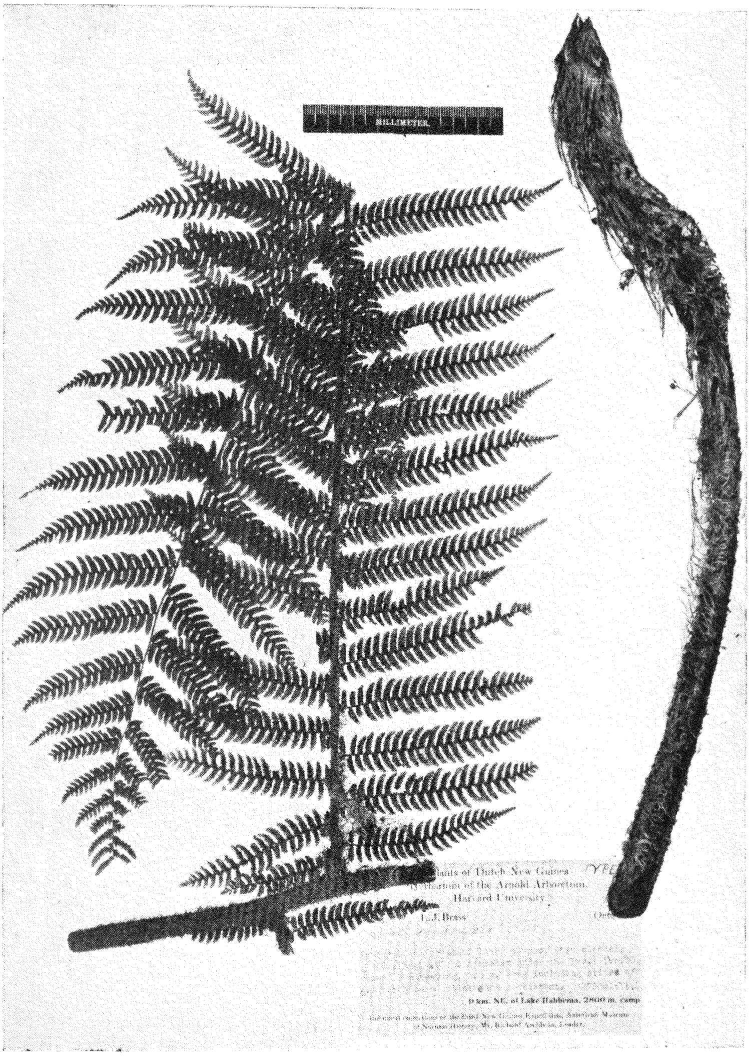

PLATE 3. CYATHEA BIDENTATA COPEL.

PLATE 4. CYATHEA GLOBOSORA COPEL.

PLATE 5. CYATHEA PACHYRRHACHIS COPEL.

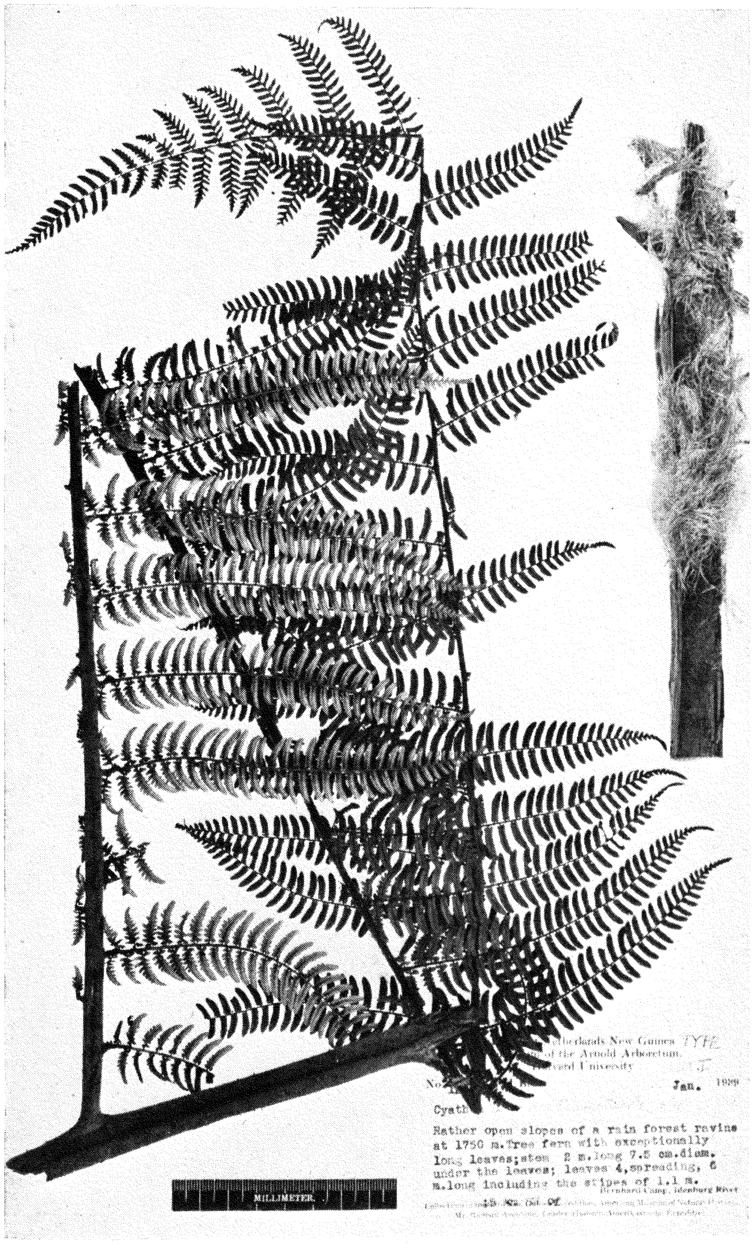

PLATE 6. CYATHEA QUADRIPINNATIFIDA COPEL.

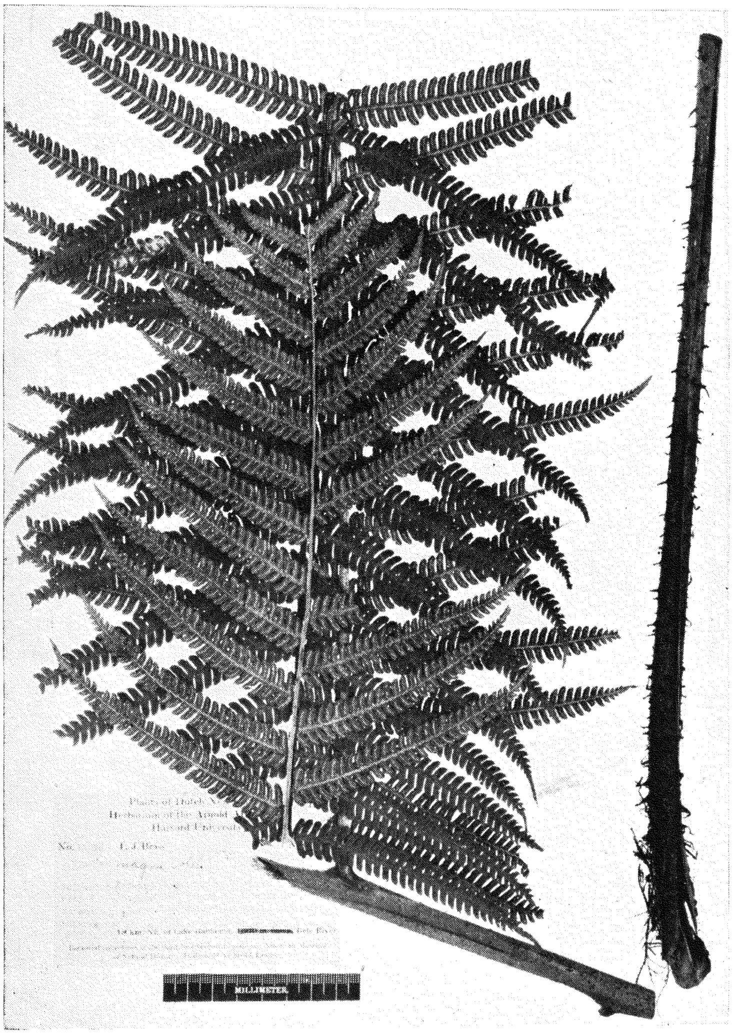

PLATE 7. CYATHEA MAGNA COPEL.

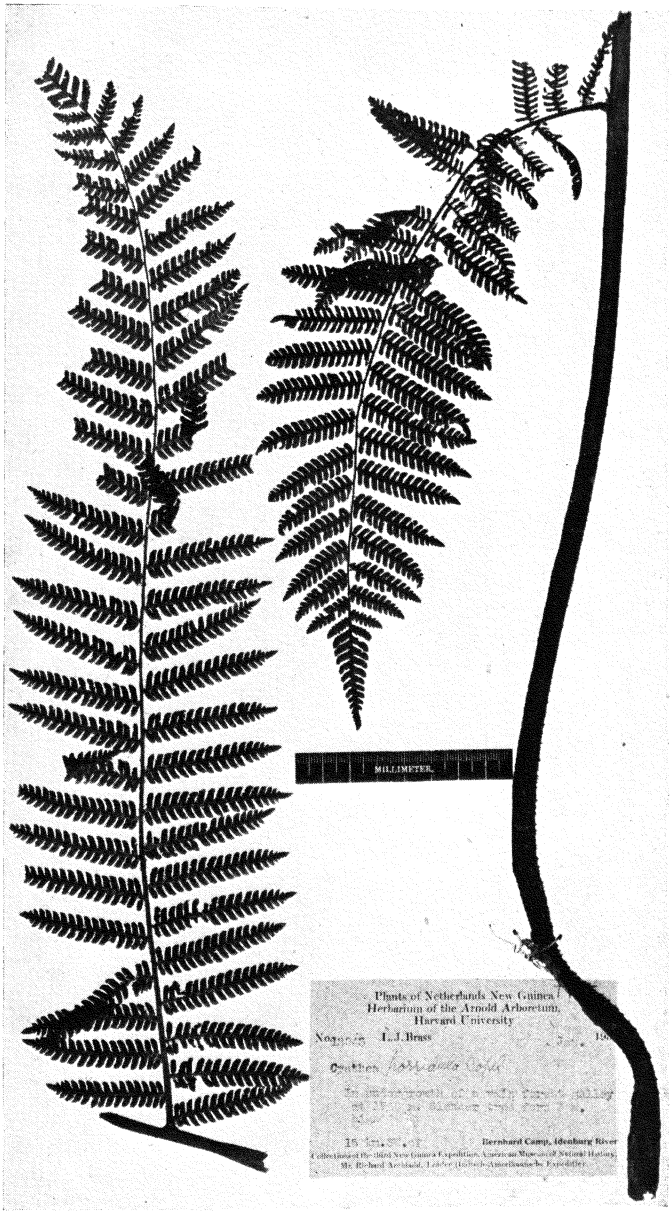

PLATE 8. CYATHEA HORRIDULA COPEL.

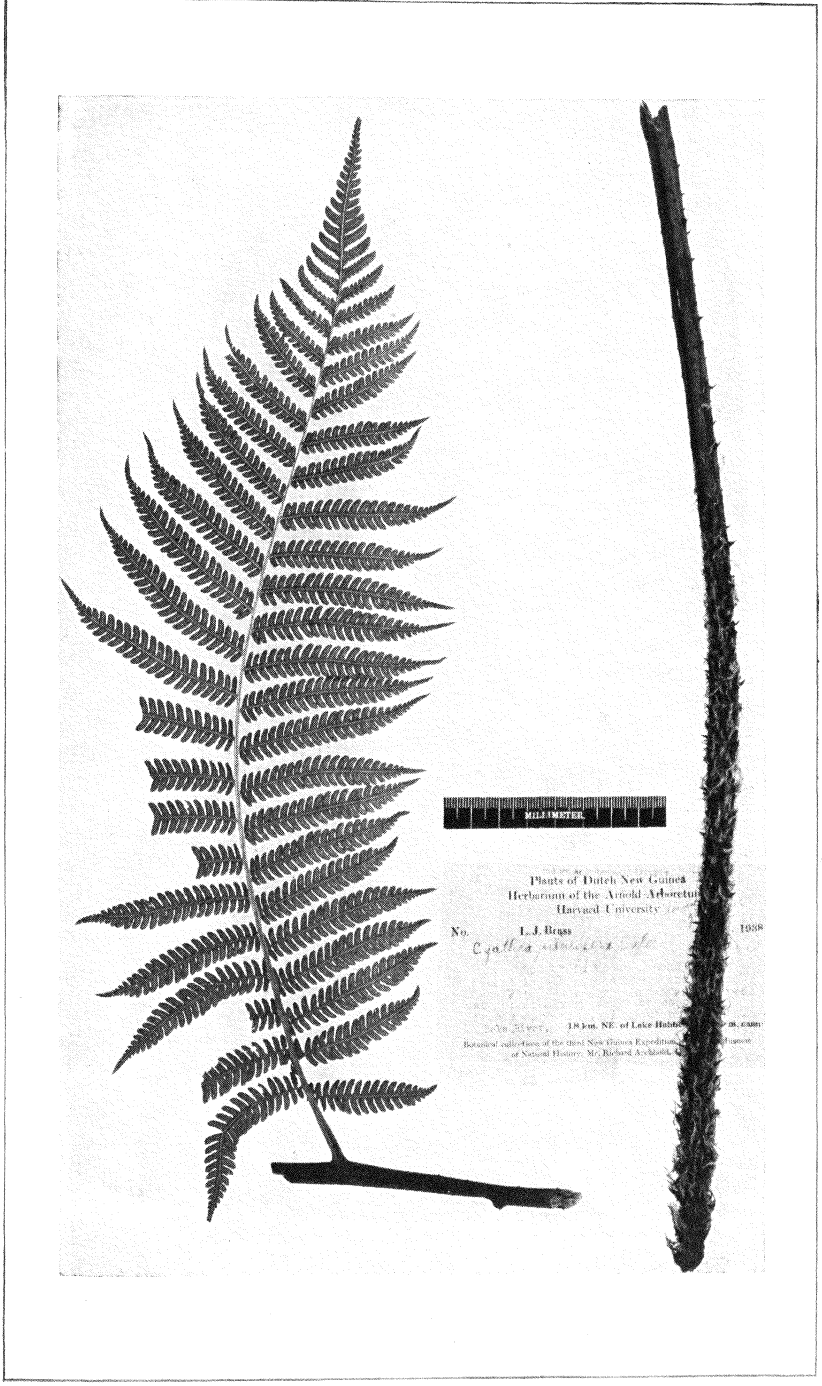

PLATE 9. CYATHEA PILULIFERA COPEL.

PLATE 10. CYATHEA MELANACANTHA COPEL.

PLATE 11. CYATHEA GRACILLIMA COPEL.

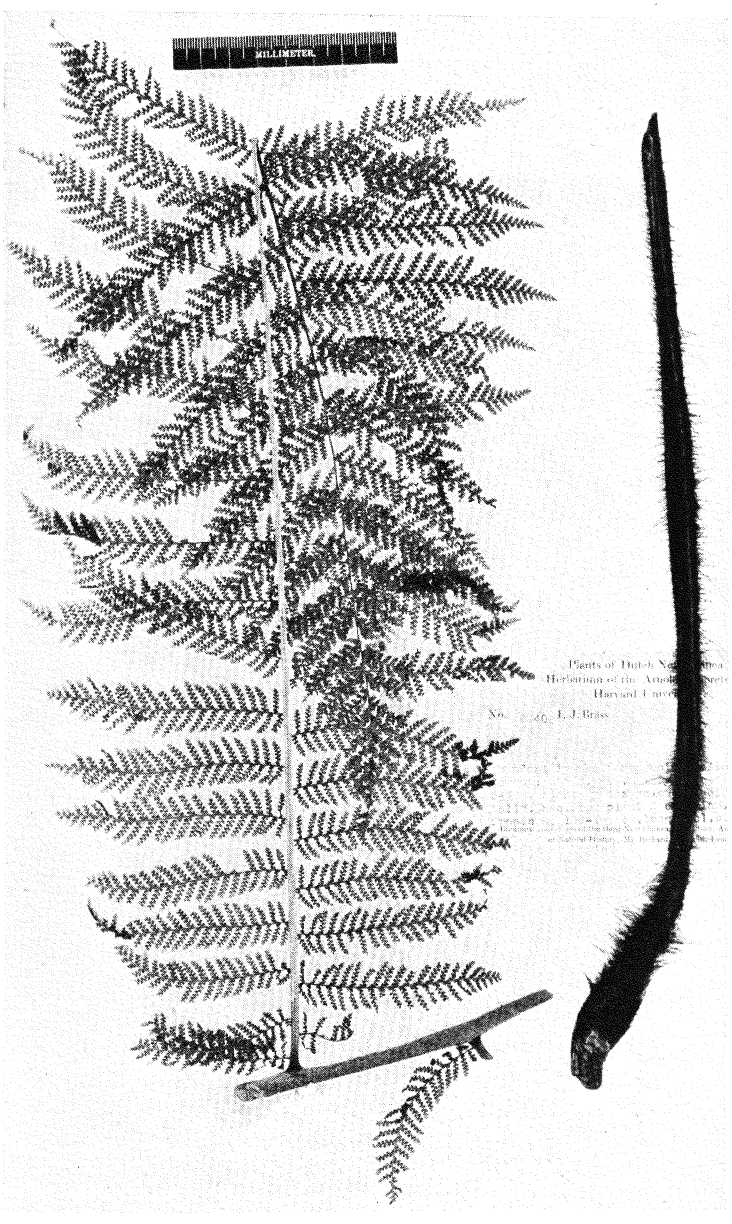

PLATE 12. CYATHEA PULCHERRIMA COPEL.

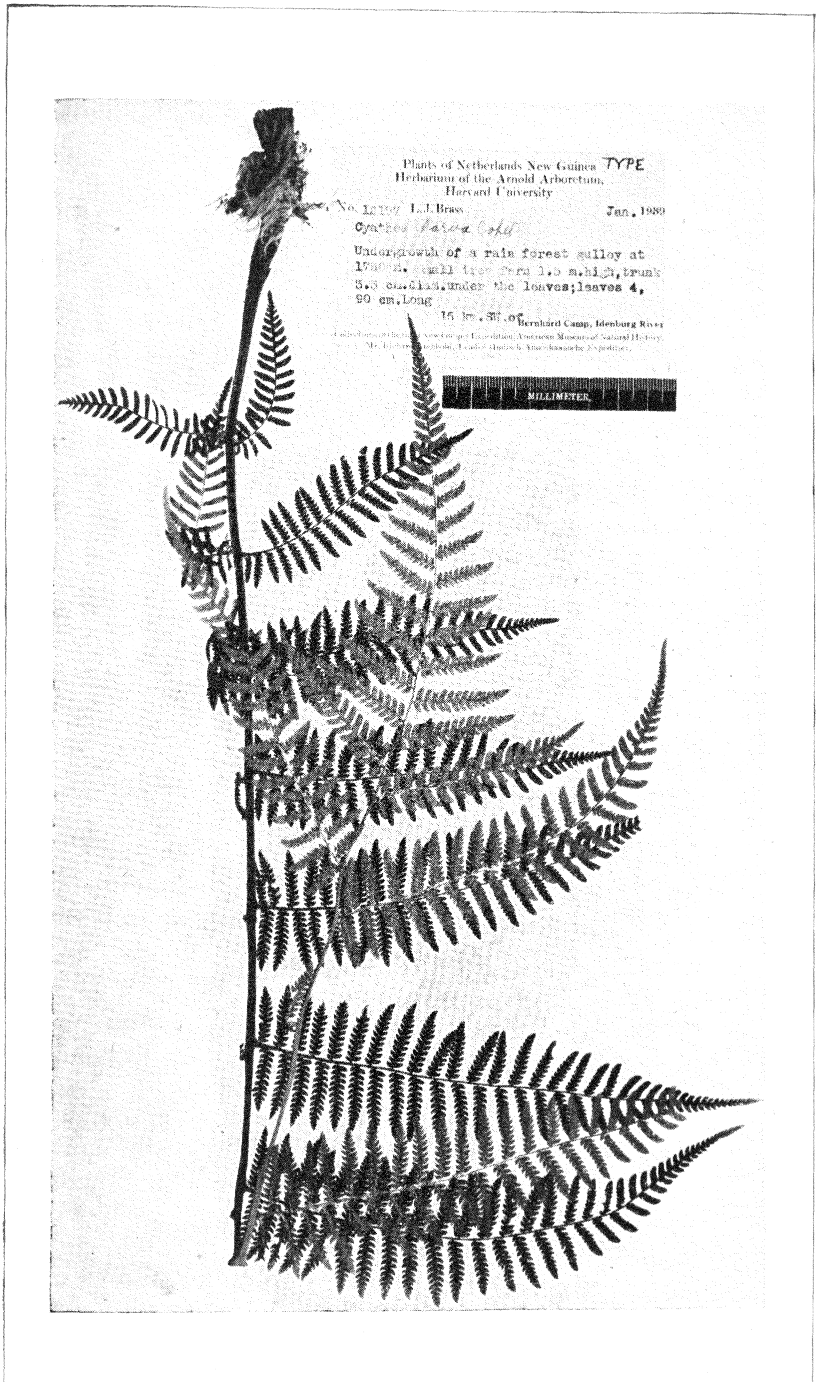

PLATE 13. CYATHEA PARVA COPEL.

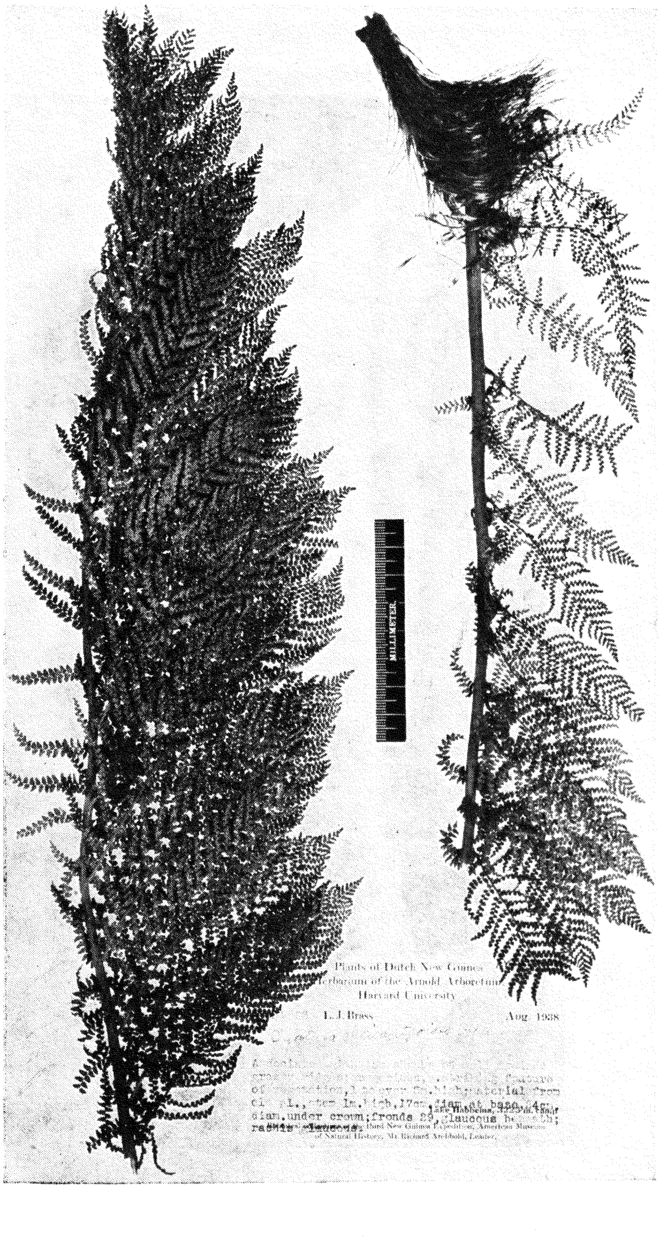

PLATE 14. CYATHEA CHEILANTHOIDES COPEL.

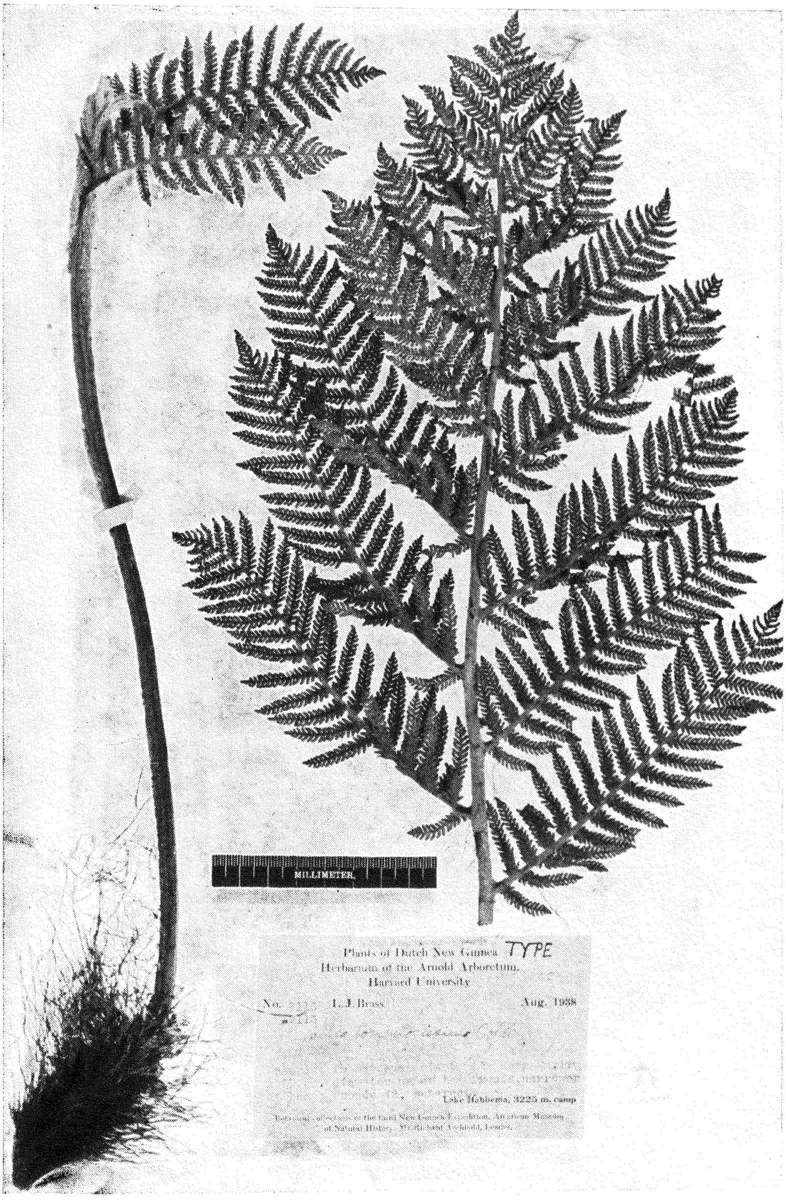

PLATE 15. CYATHEA TOMENTOSISSIMA COPEL.

PHILIPPINE PLANTS USED FOR ARROW AND FISH POISONS

By EDUARDO QUISUMBING

Of the Natural History Museum Division
Department of Agriculture and Commerce, Manila

Plants possessing poisonous properties are always of great interest. The number of plants possessing poisonous qualities in the Philippines is reputedly large, and also those recorded as dangerous to life, and useful as drugs, but few have been at all carefully studied, either by analyses or by experiments. Most of the vegetable poisons known to the Filipinos are those which contain well-known alkaloids and other active principles, which have been used as fish poisons, or used for arrows, darts, spears daggers, etc. This paper deals primarily on fish poisons and those used for arrows, darts, spears, etc.

In the preparation of this work, considerable use has been made of Merrill's Enumeration of Philippine Flowering Plants, particularly in matters of scientific and local nomenclature and geographic distribution.

The use of arrow poisons in the Philippines is confined chiefly among the non-Christian tribes, especially those living in the mountains. To these people, the bow and arrow, and the blowpipe, still constitute their principal weapons for hunting games. The plants used for poison, and the preparation of the poison vary with the tribes and localities. There are very scant data available on arrow poisons in the Philippines. It is quite often difficult to determine and discover the nature of the poisons used. These tribes are of very suspicious nature and often will give misleading statements to anyone who endeavors to ascertain the plants they employ in their preparation. It is more difficult to discover the methods they use in such preparation.

With regards to fish poisons the case is quite different. Very little difficulty was encountered even in the exact determination of the plants used. The aborigines and the Christian Filipinos have many ways of capturing fish. Some of the methods used are ancient, which have been handed down from generation to generation; others have come through contacts with civilization. Perhaps the most interesting method of fishing is the

old native custom of throwing into the water portions of plants to stupefy and later to kill the fish. With the spread of civilization and the enactment of laws, this method is becoming more and more limited. This type of fishing is destructive in a way, as it destroys small as well as large fish. The plants have been used to stupefy and kill fish in order to facilitate their capture. The practice is of great botanical and ethnological interest. Most of the plants used are wild, but a few are cultivated in the backyards of these people. Most of the poisons contained in these plants belong to certain groups of tannins, saponins, or alkaloids. Some of the plants used contain substances that may prove of value in medicine and in the manufacture of insecticides. The methods of using these plants vary a great deal with different localities. Some of the species are more virulent and potent than the others. All parts may be used in some species; in others certain parts or organs are used, such as bark, roots, fruits, and leaves. The poisons generally and usually act on the respiratory organs of the fish, producing first a stupefying effect and later death. Very often materials of one species are only used; in other cases other species are mixed. Sometimes the plant materials are mixed with earth, earthworms or some other media. The time to stupefy and kill the fish depends upon the species used.

Very little information is available on the physiological active constituents of each individual species, as very few species have been subjected to exhaustive chemical and physiological studies.

ARROW POISONS

ARACEÆ [1]

AMORPHOPHALLUS CAMPANULATUS (Roxb.) Blume.

Arum campanulatum Roxb.
Arum decurrens Blanco
Amorphophallus decurrens Kunth.

Local names: *Ánto* (Bis.); *ápon* (Tag.); *apong-ápong* (Tag.); *bagáng*, (Ibn.); *bagóng* (Bik., Sul.); *oroi* (Bis.); *pamankilon* (Bis.); *puñgápung* (Tag.); *tigi-ñga-magmánto* (Ilk.); *tokod-banuá* (Pamp.) [(41)]

The puñgápung is a very common wild herb found in thickets and secondary forests, along the roads, trails, etc., at low and

[1] The families in this work are arranged phyllogenetically; the genera and species, alphabetically.

medium altitudes in the settled areas. Also in India through Malaya to Polynesia.(41)

Burkill(10) records that the juice of this plant is mixed with *Antiaris toxicaria* juice in dart poison by the Semangs of Perak, one-tenth part making the poison strong to kill a rhinoceros or a tiger. In the Philippines we have no record of the use of this plant as an arrow or dart poison.

DIOSCOREACEÆ

DIOSCOREA HISPIDA Dennst.

Dioscorea hirsuta Blume
Dioscorea daemona Roxb.
Dioscorea triphylla Blanco

Local names: *Bagai* (Mbo.); *gáyos* (Bes.); *kalút* (Tag., Pamp., Sbl.); *karót* (Ilk.); *karóti* (Sul.); *káyos* (Tag.); *kolót* (Bis.); *korót* (S. L. Bis.); *kulót* (Sbl.); *manó* (Bik.); *namí* (Tag.); *orkót* (Bis.).

Namí is found growing wild, chiefly in thickets and forests at low and medium altitudes throughout the Philippines. It is rarely cultivated. It also occurs in India to southwestern China and Formosa through Malaya to New Guinea.

According to Gorter(20) the tubers contain a poisonous alkaloid, dioscorine. Ridley(53) quotes Schutte[2] who states that dioscorine acts as a poison resembling picrotoxin. It is a paralysant of the nervous system but not a protoplasmic poison. Leyva and Gutierrez(36) conducted a toxicological studies of namí, and concluded that the toxicity is due to an alkaloid alone. They add that besides the physiological actions of namí, it is also known to produce narcotic effect.

Burkill(10) states that the juice of the tubers are often used in criminal poisoning and is an ingredient with *Antiaris toxicaria* in the preparation of arrow poisons.

PIPERACEÆ

PIPER spp.

The Philippines is endowed with many species of *Piper,* but none have been reported as being used in arrow poisoning. Many species are sufficiently irritant to be injurious in a small degree. Burkill(10) reports that these plants are used only as adjuncts in arrow and dart poisons not only in Malaysia but also in South America.

[2] Chem. Centrab. 2 (1893) 30.

MORACEÆ

ANTIARIS TOXICARIA (Pers.) Lesch.

Ipo toxicaria Pers.

Local names: *Dálit* (Tag.); *ditá* (Ibn., Ap.); *ípo* (Tag.); *lata* (Neg.); *upas* or *ipoh* (Malaya, Java).

This species has been reported to occur in Cagayan and Apayao in Luzon, Mindoro, and Guimaras, in forests at low and medium altitudes; very local. Also found in India to southern China and Malaya.

Chopra, quoting Kiliani,(34) states that the poison contains the following constituents: (1) antiarol; (2) potassium nitrate in large amount; (3) a crystalline resin, named antiar-resin; (4) a crystalline protein; (5) an acid; (6) three active glucosides: (*a*) d-antiarin, (*b*) B-antiarin, (*c*) antiarin. These glucosides occur in varying amounts and are said to possess strong digitalislike action on the heart. Pharmacological studies show that the drug is a very powerful heart poison.

Bacon(2) studied chemically the active constituent of a small amount of arrow poison from the northern part of Mindoro, near Bulalacao, evidently the sap of a tree. The milky sap was exceedingly bitter and had a high viscosity. The results obtained indicated the presence of a glucoside rather than an alkaloid. He said that as the reactions correspond closely with those of the glucoside antiarin, from *Antiaris toxicaria*, he immediately suspected that the arrow poison in question was from this tree. Poisoned arrows obtained from the Tagbanuas at San Antonio Bay, near the south end of Palawan, were also tested. These arrows are used in blow guns, and the poison was placed on the bark and shaft. This arrow poison had a consistency like rubber and it resembled in this respect the dried sap of *Antiaris toxicaria.* Experiments were conducted with the use of guinea pigs, and he indicated that the results were typical of many others made on this powerful poison. Seligmann(58) discusses fully the physiological action of the Kenyan dart poison, *Ipoh,* and its active principle, antiarin.

The poison is also used in Tonkin, Annam, Indo-China and Burma, by all pagan tribes of British Malaya; tribes of Sumatra and Borneo, Java, Bali, Flores, Timor, Celebes, Ternate, Sunda Islands, etc. It is the chief poison in these areas, but is sometimes mixed with *Strophanthus* and *Strychnos* and others. The latex is sometimes used pure, but it is more commonly mixed with other poisons. Burkill(10) describes fully the discovery

and the use and preparation of the poison. To act, this poison must enter the blood stream. Watt(66) narrates lengthily on the use of this plant as an arrow poison. Gimlette(19) records that the milky sap of the Upan tree was formerly used in warfare by Malays as an effective poison for arrows and blowpipe darts. He further states that arrows and darts poisoned with the latex of this plant are still used by the pagan tribes of Borneo and Sumatra in intertribal warfare. He further adds that the Negritos of the east coast (Pangan and Semang) use, in addition to the sap from the bark of this tree, the bark and sap of other trees, such as the bark of *Pangium edule*, etc.; and the poisons from scorpion, centipede, and any kind of poisonous snake. Description of the various methods of preparing the poison is also included. Ridley(53) describes the tree, and the experiments conducted on the action of the poison, the remedies and antidotes, and the chemistry.

Skeat and Blagden(59) state that the Malays called the arrow and dart poison "Ipoh." Two chief substances (either separately or in combination) form its basis, and are derived from the Ipoh tree (*Antiaris*) and Ipoh creeper (*Strychnos*). *Derris elliptica* is but rarely used as an ingredient.

Speaking of *Antiaris toxicaria*, Sulit(62) describes briefly the local preparation of the poison as follows: the milky juice which flows freely when an incision is made of the bark, is a virulent poison. The Mangyans of Mindoro and the wild tribes of Cagayan, especially the Apayaos and the Negritos, dip their darts into the sap and use these in bringing down games. The Negritos of Cagayan make the poison more effective by mixing putrid meat with the juice.

According to Chopra(12) the juice derived from the leaves or the bark of the tree is distinctly poisonous. The sap is dark brown, with a gummy consistency, bitter and biting in taste. It is used to this day as an arrow poison by the Karens in Java, Malaya, and particularly in Burma. Dymock, Warden, and Hooper(14) state that in Tonkin the poison is prepared from the leaves.

MENISPERMACEÆ

COCCULUS LAURIFOLIUS DC.

The species has been reported only from Bontoc (Luzon) and Mindoro, in thickets, at an altitude of from 700 to 1,200 meters. Also found in India to China and Japan southward to Java.

Wehmer(68) records that the roots and leaves contain a toxic principle, codawin.

Caius (11) reports that the jungle tribes of the Malay Peninsula use this plant to poison their arrows and darts.

We have no record available that the plant has ever been used as arrow poison in the Philippines.

TINOSPORA RUMPHII Boerl.

Menispermum crispum Linn.
Menispermum rimosum Blanco
Tinospora crispa F.-Vill.
Tinospora cordifolia F.-Vill.
? *Cocculus cordifolius* Walp.

Local names: *Makabúhai* (Tag., Bis., Ilk.); *paliaban* (Bis.); *panauan* (Bis.); *pañgiauan* (Bis.); *pañgiauban* (Bis.); *sanñgaunau* (Bag.); *taganagtaua* (Bis.).

The species is very common, found in Luzon, Culion, and Basilan in the Philippines, in and about towns, in thickets, probably in most or all islands as it is frequently planted; perhaps introduced. Also recorded from Malaya, Ceylon, and India (under *T. crispa* Miers.).

Wehmer (68) quotes Hartwich[3] who reports that the whole plant contains a bitter principle, colombine, 2.22 per cent traces of an alkaloid; and a glucoside. He (68) further records that the plant contains an amorphous bitter principle, picroretine, and traces of berberine. Greshoff (23) isolated from the root-bark a bitter principle (which is not a glucoside) and some alkaloid. Boorsma (6) isolated from the leaves picroretin, traces of an alkaloid, and a substance similar to glyzirrhizin. In the Philippines Bacon (1) reports that the bitter, aqueous extract of the stem does not contain an alkaloid. He, however, found amorphous and resinlike substances. Feliciano, (15) who reëxamined the plant, concluded that it contains berberine, a glucoside and a bitter principle. Marañon, (39) restudying the plant, states that the bitter principle is glucosidal in nature.

While the makabúhai is a very common household medicinal plant, the juice being very bitter, yet we have no report that it is being used as an arrow poison. Caius (11) reports that the jungle tribes of the Malay Peninsula use the plant in the preparation of their arrows and dart poisons.

LEGUMINOSÆ

ABRUS PRECATORIUS Linn.

Local names: *Agaion* (C. Bis.); *aguiañgiang* (Bis.); *aroiañgiáng* (Bis.); *pañgatí* (C. Bis.); *bugaióng* (Ilk., Bon., Pang.); *bugbu-gaióng* (Ilk.); *gu-*

[3] Neue Arzneidrogen (1897) 389.

máling (Bon.); *gikos-gíkos* (Bis.); *kansasága* (Pamp., Tag., Bik.); *kaloo* (Iv.); *kasasága* (Pamp., Tag.); *lamodiak* (Bag.); *lága* (C. Bis.); *lása* (Iv.); *mañggadolong* (Bis.); *oiñgia* (Bis.); *mátang-púne* (Bis.); *sága* (Tag.); *saga-sága* (Tag.); *saga-mamín* (Tag.).

Very common vine throughout the Philippines at low and medium altitudes, in thickets. Pantropic in distribution, although probably a native of tropical Asia.

Wehmer(68) records that the seeds contain a toxalbumin, abrin, which is very toxic; abralin; abrussic acid, hemaglutinin, lipase and urease.

Sulit(62) gives the following account of this species as an arrow poison. He says that the seeds are powdered and formed into a pastelike mash with which the darts or arrows are dressed. Wounds caused by arrows poisoned with this mash are generally fatal within 24 hours. Boiling the seeds renders the poison ineffective. Local tribes seldom avail themselves of this poison on account probably of its slow effect. According to Burkill(10) the poisonous substance in the seeds is abrin.

DERRIS ELLIPTICA (Roxb.) Benth.

Galedupa elliptica Roxb.
Cylista piscatoria Blanco
Galactia terminaliflora Blanco
Millettia splendidissima Vidal
Millettia piscatoria Merr.

Local names: *Báuit* (Tag.); *lapák* (Bik.); *malasiag* (Tag.); *tibalau* (Tag.); *tibanglán* (Tag.); *tubali* (Tag.); *tublí* (P. Bis., Tag., Buk.); *tuglí* (Tag.); *tuglíng-pulá* (Tag.); *tuva* (Iv.); *upei* (Bon.).

Tublí is a very common species, its distribution in the Philippines extending from northern Luzon to Mindanao. It is also found in Chittagong, through Malaya to New Guinea and the Bismarck Archipelago.

Wehmer(68) records that the roots contain a toxic principle, rotenone.

According to Gimlette(19) the sap of this plant combined with that of *Antiaris toxicaria* is used in Borneo as one of the ingredients of the Kayan dart and arrow poison for hunting. A similar use of the sap by the pagan tribes of the Malay Peninsula was reported by Newbold,(43) and by Ridley.(53) While the species is quite abundant in the Philippines, its use has only been limited to fish poison and as an insecticide.

DERRIS TRIFOLIATA Linn.

Robinia uliginosa Roxb.
Balbergia heterophylla Willd.
Galedupa uliginosa Roxb.

Pongamia uliginosa DC.
Pterocarpus frutescens Blanco
Derris uliginosa Benth.
Derris diadelphus Naves

Local names: *Asiasimánan* (Tag.); *butong* (Bis.); *hiñgasín* (P. Bis.); *hiñgasínan* (P. Bis.); *manñgasín* (Tag.); *sabuko* (Bag.); *salasíla* (Tag.); *tuba-tuba* (Yak.).

Derris trifoliata is found abundantly throughout the Philippines on muddy shores, along tidal streams, etc. It occurs also in tropical East Africa, Asia, through Malaya to Australia and Polynesia.

According to Power(49) the plant contains considerable amount of tannin and red coloring matter. Besides gum and sugar the stems contain an appreciable amount of inorganic salt, notably potassium nitrate. Power states that the toxic effect on fish, however, is evidently due to some constituent of that portion of the resin which is soluble in chloroform and not to the tannin which the plant contains. He further says that no alkaloid was found by him.

Burkill(10) quotes Perrot and Vogt[4] who state that in the Island of Aurora, New Hebrides, arrows which have been poisoned by dipping their heads into a corpse are further poisoned by means of an infusion of this plant.

MUCUNA PRURIENS (Linn.) DC.

Dolichos pruriens Linn.
Stizolobium pruriens Medic.
Carpopogon pruriens Roxb.
Negretia pruriens Blanco
Mucuna atropurpurea F.-Vill.

Local names: *Hípoi* (Bik.); *ípe* (Pamp.); *lípai* (Tag.); *nípai* (Bis., Tag.); *nípoi* (Bik.); *cowhage* (Engl.).

Mucuna pruriens is found in Rizal and Laguna Provinces in dry thickets and secondary forests at low altitudes. It also occurs in India to Malaya.

The Mucunas are noted for possessing very irritating hairs. The irritation is often so intense that they are generally regarded as poisonous. The hairs produce notable itching first followed by pain, redness, swelling and even an eruption. According to Grieve(24) the hairs of the pods are usually filled with air, but sometimes contain granular matter, with tannic acid and resin.

[4] Trav. Lab. Mat. Med. Paris 12 (1913) 238.

According to Dalziel(13) the stinging hairs of this species and other species are sometimes used as an accessory ingredient in arrow poison in West Tropical Africa.

RUTACEÆ

LUNASIA AMARA Blanco.

Pilocarpus amara Blanco
Rabelaisia philippinensis Planch.
Lunasia philippinensis F.-Vill.
Lunasia reticulata Elm.

Local names: *Apdong-káhoi* (Tag.); *bungláì* (Bik.); *dayangdang* (Ilk.); *labau* (S.L.Bis.); *lubi-lubi* (C.Bis.); *lunas* (Tag.); *pait* (Bik., Tag.); *paítan* (Bis., Ilk.); *palatañgan* (Cad.); *papait* (Bik.); *saltiki* (Tag.); *santiki* (Tag.).

Common plant reported from northern Luzon to Mindanao, and Palawan, in thickets and forests at low and medium altitudes. Endemic.

Wehmer(68) records that the bark contains a glucoside, rubelaisine, and two amorphous alkaloids, lunacrine and lunasine.

The use of this plant as an arrow poison is doubtful. Brill and Wells(7) mention the confusion in names as due to the fact that this plant has been confused with *Lophopetalum toxicum* by earlier workers.

MELIACEÆ

LANSIUM DOMESTICUM Correa.

? *Baccaurea sylvestris* Lour.
? *Melia parasitica* Osbeck

Local names: *Boboa* (Bis.); *buahan* (Mbo.[5], Sul.); *bulahan* (Bis.); *buan* (Mbo.); *bukan* (Bis.); *kalibonĝan* (Mbo.); *lansónes* (Tag., Bik.); *tubuan* (Bag.).

Lansones is cultivated in the Philippines, and semiwild in certain parts of Mindanao. It is also found in Indo-China, Malay Peninsula and Archipelago.

Wehmer(68) records that the bark and skin of the fruits contain an amorphous toxic, lansium acid; the seeds contain a bitter principle and traces of alkaloid.

The tree is not reported here as a source of arrow poison. Burkill(10) quotes Perrot and Vogt[6] who record that the latex is used as a Dyak arrow poison.

[5] The abbreviations for the various local dialects and languages were adopted from Merrill's(41) Enumeration of Philippine Flowering Plants.

[6] Trav. Lab. Mat. Med. Paris 9 (1913) 206–216.

Ap.	Apáyao
Bag.	Bagobo
Bik.	Bíkol
Bil.	Bilá-an
Bis.	Bisaya
P. Bis.	Panay Bisáya
C. Bis.	Cebu Bisáya
S. L. Bis.	Samar-Leyte Bisaya
Ak. Bis.	Aklan Bisáya
Bon.	Bontók
Buk.	Bukidnon
Chab.	Chabacáno
Dum.	Dumágat
Gad.	Gaddáng
Ibn.	Ibanág
If.	Ifugao
Ilk.	Iloko
Ig.	Igorot
Ilg.	Ilongót
Is.	Isinái
Ism.	Isámal
Iv.	Ivatán
Kul.	Kuláman
Kgl.	Kalínga
Kuy.	Kuyonon
Lan.	Lanao
Mag.	Magindanáo
Mang.	Mangyán
Mand.	Mandáya
Mbo.	Manóbo
Mng.	Mangguángan
Neg.	Negrito
Pamp.	Pampagán
Pang.	Pangasinán
Sbl.	Sambáli
Sml.	Sámal
Sp.	Spanish
Sul.	Súlu
Sub.	Subánun
Tag.	Tagálog
Tagb.	Tagbanúa
Tagk.	Tagaká-ólo
Ting.	Tinggián
Tir.	Tirurái
Yak.	Yakán

EUPHORBIACEÆ

CROTON TIGLIUM Linn.

Croton camaza Perr.
Croton glandulosum Blanco
Croton muricatum Blanco
Tiglium officinale Klotz

Local names: *Gasi* (Sul.); *kámagsa* (Bik.); *kamísa* (Tag.); *kamandag* (Bis.); *kamausa* (Tag.); *kásla* (Sul.); *lutung-sira* (Bik.); *makáisa* (Tag.); *makásla* (P. Bis.); *Malapai* (Sul.); *Salígau* (Ilk., Ibn.); *túba* (Ilk., Bik., Tag.); *tubang-makaísa* (Bik., Tag.); *tubang-pasíti* (Bik.); *túbli* (C. Bis.); *túkbu* (If.).

This species is of prehistoric introduction into the Philippines, found throughout the Archipelago in and about towns, usually planted, sometimes naturalized. Also found in India to New Guinea.

Wehmer(68) records that the seeds contain a toxic alkaloid, ricinine. The bark contains 65 per cent tannin. Gimlette(19) also says that various glycerides, glycerin esters, acids, and especially the irritant crotoleic acid, are contained in croton seeds; they also contain croton-resin from which they derive their vesicant properties, and crotin, a toxic albuminoid principle. Crotin is a vegetable toxalbumin which is chemically

similar to ricin, the toxalbumin of castor oil beans; it also resembles abrin, the toxalbumin of *Abrus precatorius* seeds.

Croton tiglium, according to Burkill,(10) supplies the Arbors of the Eastern Himalaya with an arrow poison. The bark is the part used. The leaves are said to furnish the Bataks of Sumatra with an arrow poison. Gimlette(19) also reports that the leaves are also used as one of the constituents of the Batak arrow poison. He further states that the Arbor arrow poison of the northeastern frontier of Assam is a paste believed to be made by pounding the soft parts of this plant. Waddell(65) reports also that the poisoned arrows of the Arbor tribe of Assam were found to contain croton oil.

The plant is not reported as having been used as an arrow poison in the Philippines. It is on the other hand universally used for poisoning fish.

EXCOECARIA AGALLOCHA Linn.

Local names: *Alipáta* (P. Bis.); *batáno* (Ilk., Pang.); *bota-bóta* (Tag., Bis.); *búta* (Tag.); *buta-búta* (Tag., Pamp., Sul.); *dipodáta* (C. Bis.); *gumaiñgat* (Bag.); *himbabau* (Pamp., Bis.); *liñgi* (Sbl.); *lipáta* (Bik., Bis., Tag.); *lipátang-buhai* (Tag., Sul.); *siak* (Bis.).

This is a very common species throughout the Philippines along the seashore or within the influence of salt or brackish water. It is also found from India to Polynesia.

Despite the abundance of this plant in the Philippines no report is available that it is being used for poisoning arrows. According to Burkill(10) the latex is used in Malacca, Selangor, and Johore as an adjunct to *Antiaris* sap in making dart poison. Ridley(53) also mentions this plant as being used in dart poison by the wild tribes of Malay Peninsula. In Queensland Hedley(27) reports that the latex is used by the black natives of Port Curtis as a poison for their spears.

JATROPHA CURCAS Linn.

Local names: *Galúmbang* (Pamp.); *kásla* (Bis.); *kirisól* (Tag.); *tabatabá* (Tag.); *tagumbáu* (Ilk.); *tagumbau-na-puráu* (Ilk.); *takumbau* (Sbl.); *tañgan-tañgan-túba* (Tag.); *taua-tauá* (Ilk., Ig.); *tauuá* (Ilk.); *túba* (Ig., Bik., Tag.); *túbang-bákod* (Tag.); *physic nut tree, purging nut tree, big purge nut* (Engl.).

Jatropha curcas is found throughout the Philippines and usually very common in and about towns. It was introduced at an early date in colonial history from Mexico, and now pantropic in distribution.

Wehmer(68) records that the seeds contain a toxic principle, toxalbumin curcin. According to Steyn(61) curcin belongs to the same group of toxalbumins as crotin and ricin. The lesions in animals injected intravenously and subcutaneously with curcin are similar to those seen in crotin and ricin poisoning, with the exception that in the case of the former poison (curcin) there is less irritation in the gastro-intestinal tract. The external and internal actions of the oil are similar to those of croton oil, due to the presence of the above acid (crotonoleic type).

According to Dalziel(13) some tribes in the West add the nut to *Strophanthus* seeds in making arrow poison. It is also sometimes an ingredient, along with the latex of *Euphorbia* in the mixture called in Hausa, "gunguma" (Nupe lowu), used to poison corn as a bait for Guinea-fowl.

CELASTRACEÆ

LOPHOPETALUM TOXICUM Loher.

Lophopetalum fimbriatum F.-Vill.
Hippocratea maingayi Vidal

Local names: *Abúab* (Tag.); *abútab* (Tag.); *butiñgi* (Tag.); *buyun* (Sul.); *dayandáng* (Tag.); *ditá* (Neg.); *kalibámbagan* (Mand.); *puti-i-bábae* (Lan.); *buti-i-lalaki* (Lan.); *sudkad* (P. Bis.).

The plant has been reported from Rizal, Tayabas, Laguna, and Camarines Provinces in the Island of Luzon; Mindoro; Masbate; Leyte; and Lanao, Zamboanga, and Davao Provinces in Mindanao; and the Sulu Archipelago, in primary forests at low altitudes. Endemic.

Brill and Wells(7) report that the plant contains a physiologically active substance, a saponin, which is poisonous in small quantities. Boorsma(5) isolated a glucoside and named it lophopetalin.

Loher(37) first described this plant, and supplementary to the diagnosis of the species he reported the use of this plant as an arrow poison by the Negritos. Guerrero(25) also reports that the thickened sap of the bark is used by the Negritos and other hillsmen to poison the tips of their arrows.

Brill and Wells(7) investigated the physiological active principle of the plant. They mention that it is well known among the mountain people of some parts of the Philippines, because of the use they make of its bark to poison their arrows, spears and other weapons. The Remontados and Negritos of Rizal Province, these authors further mention, easily prepare the poison. The method is as follows: the bark is removed, soaked,

and bruised. The expressed juice is then evaporated to the consistency of an emulsion. In its preparation care should be taken not to let it come in contact with any sour substances in order not to diminish or neutralize its deadly action. Due to its reaction to warm acids, it is reported that poison is glucosidal compound. It is further stated that the natives always concentrate the juice, as they believe it is harmless when in dilute condition. The change taking place in the dilute juice is probably a hydrolysis to harmless sapogenin by the action of various ferments. They say that heating destroys these ferments and as yeasts will not grow in the concentrated juice, there are no further changes after concentration. They also describe the method used in isolating the poison. They arrive at the conclusion that the plant contains a physiologically active substance, a saponin, which is poisonous in small quantities.

Sulit(62) reports that the bark of this plant yields the poison. He described the preparation of the poison as follows: Sufficient quantity of the bark is triturated and the mash is sprinkled with water. This is placed in a pocket-shaped rattan basket especially made for the purpose and then pressed to extract the juice. The juice is placed in a brass kettle or pot and boiled. During the process of boiling, dried powdered leaves of *Mallotus floribundus* are added to the solution, the liquid being stirred once in a while with a flat stick. When the solution becomes sticky the pot is taken from the fire to cool. After cooling the sticky substance is ready for dressing the arrows. The poison, he reports, is used extensively by the Manobos of Cotabato Province, in Mindanao, and by the Negritos of Tayabas Province.

THEACEÆ

TERNSTROEMIA spp.

The bark of certain species is used as arrow poison and as fish poison in the Philippines. According to Burkill(10) the active principle isolated seems to be a saponin.

GUTTIFERÆ

CALOPHYLLUM INOPHYLLUM Linn.

Local names: *Bangkálan* (Tag.); *batarau* (Neg.); *bitaog* (Ilk., Sbl., Pamp., Tag.); *bitok* (Tag.); *butalan* (Tag., S. L. Bis., C. Bis., Mbo.); *bitaoi* (Pang.); *bitong* (Tag.); *dagkálan* (Tag.); *dangkáan* (Bag.); *dangkálan* (Tag., Bik., P. Bis., Mag.); *dingkálan* (Big., Tag.); *lankágan* (Mag.); *palo-maria* (Neg., Tag., C. Bis., Sul.); *palo maria de playa* (Tag., Sp., Sul.); *pamitaogen* (Ilk.); *tambotambok* (Sul.); *vutalau* (Iv.).

Palo-maria is a characteristic strand tree, throughout the Philippines. It is also found in India to tropical East Africa through Malaya to Polynesia.

Richmond and del Rosario(51) report that kernels contain 70 to 75 per cent bitaog oil and that the oil contains a poisonous resin.

Although the plant is abundant in the Philippines, we have no record that it is being used for arrow and spear poisons. Our knowledge of the use of this plant for spear and arrow poison is due to Reverend Powell,(48) who gives us an account of the use and virulence of the poison in Samoa.

FLACOURTIACEÆ

PANGIUM EDULE Reinw.

Hydnocarpus polyandra Blanco

Local names: *Pañgi* (S. L. Bis., P. Bis., Bik., Tag.); *salingkumut* (Mand.).

Pañgi is known in the Philippines for its edible seeds. It is reported from Camarines and Sorsogon Provinces, Luzon; Palawan, Samar, Leyte, Panay, Negros, and Mindanao, growing in primary forests at low and medium altitudes. It is also reported from Malay Peninsula and Archipelago.

The toxic property is due to a cyanogenetic glucoside, gynocardine, isolated by De Jong.(32)

No record is available of the use of the plant as an arrow poison in the Philippines. Gimlette(19) cites Vaughan Stevens as authority for the use of this plant as an arrow poison, to the effect that the fresh seeds are used in making dart poison by the Pangan jungle tribes. Gimlette(19) adds that the Negritos of the east coast (Pangan and Semang) use in addition to the sap from the bark of *Antiaris toxicaria*, the bark from *Pangium edule* for arrow poisons. Ridley(53) lists this plant also as being used in the manufacture of dart poison by the Sakais and other wild tribes of Malay Peninsula.

EBENACEÆ

DIOSPYROS MULTIFLORA Blanco.

Diospyros lotus Blanco
Diospyros canomoi A. DC.

Local names: *Kanomai* (Ilk.); *kanomoi* (Tag.); *kanumai* (Ilk., Tag.); *maratampui* (Ilk.).

Reported from Luzon (Cagayan, Ilocos Sur, La Union, Pangasinan, Nueva Ecija, Pampanga, Rizal, Laguna, and Batangas Provinces); Leyte; and Zamboanga Province in Mindanao, as

growing in thickets and primary and secondary forests at low and medium altitudes. It is endemic.

The Negritos of Bataan Province poison their arrows by using the bark of this tree. Specimens of this plant brought into the Bureau of Science laboratories have been found to be moderately toxic.(1, 2) It was reported as *Diospyros canomoi*, which is a synonym of this species.

LOGANIACEÆ

STRYCHNOS NOX-VOMICA Linn.

The strychnine tree is of very recent introduction into the Philippines. According to Sulit(62) this species has long been known and used for arrow poison by the wild tribes in Malaya. The poison is obtained from the bark by maceration in water. According to Wehmer(68) the bark yields strychnine and brucine.

APOCYNACEÆ

CERBERA MANGHAS Linn.

Cerbera odollam Gaertn.
Cerbera lactaria Ham.
Elcana seminuda Blanco

Local names: *Arbon* (Tagb.); *baraibai* (Tag.); *batáno* (Ilk.); *buta-butá* (Tag.); *butó-butó* (C. Bis.); *ditá* (Sul.); *dungas* (Mag.); *kaliptan* (Ilk.); *lipáta* (Tagb.); *lipátag* (P. Bis.); *magkanai* (Bik.); *maraibai* (Tag.); *marabai* (Tag.); *panabulon* (P. Bis.); *totok-kálau* (Tag.); *tabau-tabau* (Ilk.).

Common along the seashore throughout the Philippines. It is also reported from tropical Asia through Malaya to tropical Australia and Polynesia.

Wehmer(68) records that a glucoside, cerberine, was isolated from the seeds. A bitter principle, odollin, was also isolated. Gimlette(19) states, on the other hand, that a glucoside known as thevetin, a cardiac poison, which also occurs in *Thevetia peruviana*, has been found in the milkylike juice of all parts of this plant.

Gimlette,(19) in his interesting book of Malay poisons and charms, mentions the use of the oil expressed from the seeds of this plant, in certain parts of the Dutch East Indies to smear on spears and daggers to poison the blade.

Despite the abundance of the plant in the Philippines, no record is available that it is used as an arrow poison.

STROPHANTHUS CUMINGII A. DC.

Strophanthus dichotomus DC. var. *luzoniensis* Vidal
Strophanthus erectus Merr.

Local names: *Abúnag-báging* (Tag.); *lánot* (Ilk.); *lasíu* (Ibn.); *sara-sara* (Ilk.).

Reported from Cagayan, Abra, Ilocos Norte, La Union, Batangas, Rizal, Cavite, Bataan, Laguna, and Sorsogon Provinces in Luzon; Palawan; Leyte; Negros; and Davao Province in Mindanao, growing in thickets and forests at low and medium altitudes. It is endemic.

Brown(8) reports that the bark is employed as an effective arrow poison. Sulit(62) also records this species as useful arrow poison.

VERBENACEÆ

CLERODENDRON VILLOSUM Blume.

Clerodendron infortunatum Walp.
Clerodendron Curranii Elm.

Clerodendron villosum is found in old clearings, thickets, etc., at low altitudes in Culion, Palawan, Balabac, Bancalan. It also occurs in Burma, Malay Peninsula, Penang, Sumatra, Java, and Borneo.

According to Chopra(12) the plant contains a bitter principle. Skeat and Blagden(59) say that the Manteras use the leaf for skimming dart poison.

CUCURBITACEÆ

MOMORDICA CHARANTIA Linn.

Momordica balsamina Blanco
Momordica cylindrica Blanco

Local names: *Amargóso* (Sp.); *ampalayá* (Tag.); *ampaliá* (Tag.); *apalayá* (Tag.); *apaliá* (Pamp.); *apápe'* (Ibn.); *apápet* (Itn.); *margóso* (Tag.); *paliá* (Bis., Bon., If.); *pariá* (Bik., Ilk., Sul.); *puliá* (Sub.); *saligun* (Sul.); *balsam apple, balsam pear, African cucumber, tuberculated Momordica, bitter gourd* (Engl.).

Ampalayá is found throughout the Philippines, in cultivation and also thoroughly naturalized in thickets, waste places, etc., at low and medium altitudes. It is pantropic in distribution.

Greshoff(22) reported in 1898 the presence in the leaves of a bitter alkaloid and a glucoside. In 1904 Peckolt(46) isolated from the leaves and fruits a bitter principle, momordicin.

Steyn(61) quotes Descourtilz, who states that two or three drachms of the fruits taken internally will kill a dog.

According to Dalziel(13) some Benue tribes include the plant as an ingredient in *Strophanthus* arrow poison.

FISH POISONS

ARACEÆ

ALOCASIA MACRORRHIZA (Linn.) Schott.

Arum macrorrhizon Iinn.
Calla maxima Blanco
Arum grandifolium Blanco
Calla badian Blanco
Alocasia indica Naves

Local names: *Abá* (Ibn.); *aba-ába* (Ig.); *badiáng* (Tag., Bis.); *bagiáng* (Bis.); *bira* (Ilk.); *bíga* (Tag., Ilk., Bis., Pamp.); *bilbíla* (Bon.); *gabí* (Bik.); *galiáng* (Bis.); *gandus* (Pamp.); *malabíga* (Tag.); *ragiáng* (Bis.); *sininába* (Ilk.); *talípan* (Bik.); *taliáng* (Bis.).

Bíga is common throughout the Philippines, in old clearings and secondary forests, at low and medium altitudes. Also reported from India to Malaya. It is planted for ornamental purposes in other tropical countries.

The juice from the trunk and leaves is an irritant. No report, however, is available that the plant is being used locally for poisoning fish. In Queensland, particularly in Monduran and among the upper Burnett blacks, Hamlyn-Harris and Smith(26) record the plant as a fish poison. They say that the leaves of this plant are cyanophoric. Howes(31) also mentions this plant as a fish poison in Australia.

DIOSCOREACEÆ

DIOSCOREA HISPIDA Dennst.

Dioscorea hirsuta Blume
Dioscorea daemona Roxb.
Dioscorea triphylla Blanco

Local names: *Bagai* (Mbo.); *gáyos* (Bis.); *kalút* (Tag., Pamp., Sbl.); *karót* (Ilk.); *karóti* (Sul.); *káyos* (Tag.); *kolót* (Bis.); *korót* (S. L. Bis.); *kulót* (Sbl.); *mamó* (Bik.); *namí* (Tag.); *orkót* (Bis.).

Namí is found growing wild, chiefly in thickets and forests at low and medium altitudes throughout the Philippines. It is rarely cultivated. It also occurs in India to southwestern China and Formosa through Malaya to New Guinea.

Regarding the active principle, physiology and toxicology of namí, see under Arrow Poison.

Namí tubers when fresh are crushed or chopped to pieces and are used to poison fish.

MYRICACEÆ

MYRICA RUBRA S. & Z.

Morella rubra Lour.

Common names: *Cham-poi* (Tag.); *Cham-pu* (Chinese); *box myrtle, bay berry, Chinese strawberry* (Engl.).

Myrica rubra is found in Zambales Province in Luzon, and in Palawan, on the higher mountains. It also occurs in Japan, China, Korea, and Formosa.

Wehmer(68) records that the bark contains myricitrin isolated by Shibata and Kimotsuki.[7]

There is no local record of its use as a fish poison. Greshoff(22) reports that in the Khasia hills the bark is used to poison fish.

POLYGONACEÆ

POLYGONUM BARBATUM Linn.

Polygonum stoloniferum Blanco
Polygonum persicaria Walp.

Local names: *Bukákau* (Bik.); *kanubsúban* (Pamp.); *kaykáyu* (If.); *saimbañgan-tubig* (Sul.); *sigan-lúpa* (Tag.); *subsúban* (Tag.).

Polygonum barbatum is a fairly common species distributed from northern Luzon to Mindanao, growing in open, usually wet, places, at low and medium altitudes, ascending to 1,400 meters in some regions. It is also found in India to Africa to Malaya.

According to Kalaw and Sacay(33) the leaves and roots are poisonous to fish in the Philippines.

POLYGONUM ORIENTALE Linn.

This species is found in Pampanga and Rizal Provinces in Luzon; and in Lanao and Bukidnon Provinces in Mindanao, in open waste places along streams, at low and medium altitudes. It is also found from India to Japan southward to Australia.

Maurin(40) reports the presence of 0.50 per cent of oxymethylanthraquinone in the leaves.

Although the species is present in the Philippines, we have no record of its use as a fish poison. The Port Curtis blacks in Queensland, according to Roth,(54) use this plant for obtaining fish. The plant is pounded and thrown into a water-hole, thus

[7] Act. Phytochim. Tokyo (1923).

bringing all the fish to the surface in a dying condition without their wholesomeness as food being impaired.

MENISPERMACEÆ

ANAMIRTA COCCULUS (Linn.) W. & A.

Menispermum cocculus Linn.

Local names: *Arai* (Bag.); *balasin* (Tag., Bis.); *bayáti* (Tag.); *bayatíng* (Ilk.); *lábtang* (Ilk., Ig.); *lágtal* (Bis.); *lágtang* (Bis., Mbo., Sul.); *lákdang* (Bis.); *láktang* (Tag., Bis., Pamp.); *lánta* (Tag., Pamp.); *ligtang* (Tag.); *liktang* (Tag., Bis.); *suma* (Tag.).

This species is common from northern Luzon to Mindanao, growing in thickets at low and medium altitudes. It is also found in India, through Malaya to New Guinea.

Wehmer (68) records that the seeds contain bitter principles —picrotoxin, picrotoxinin, picrotin, and cocculin; and two alkaloids—menispermine and paramenispermine.

This plant is one of the commonest used as a fish poison in the Philippines. Tavera (63) reports that the fruits are thrown in small streams or in lakes to stupefy fish. According to Bacon (1) the fruits are the parts of the plant used for fish poisoning. The action of the substance is due to the very poisonous bitter principle, picrotoxin. Poisoning due to eating the fish obtained by this means has often occurred.

Brown (8) states that the powdered fruits of this plant are put in water to kill fish. In preparing the poison the fruit is first heated until dry and then crushed and powdered. The fruits are poisonous not only to fish, but also to other animals.

Kalaw and Sacay (33) mention also the fruit as the part used in poisoning fish. They say that hydrocyanic acid is present in the leaves, bark and roots; saponin is present in all these parts. According to Watt (66) the bitter fruits are used in India to poison fish. Howes (31) records that this species is one of the best known of Asiatic fish poisons, and its fruits have long been known to possess peculiar and poisonous properties. Their use for this purpose has even extended to European countries, and it is stated that, as a result of cases of poisoning among those who have consumed fish caught in this way, it has been found necessary in some countries to forbid the sale of the berries except to pharmacies. Cases are on record of poachers making use of the berries for capturing trout in some of the English rivers. A common method of using the berries in Eastern countries is to grind them to a powder and then make into a thick

paste with boiled rice. In this form a small quantity is sufficient to render fish, birds, and certain animals insensible. As an alternative the berries in a partly crushed state may be thrown into the water. Russell (55) also reports the toxic properties of the fruits due to an alkaloid, menispermine, and to picrotoxin.

CISSAMPELOS PAREIRA Linn.

Cissampelos discolor DC.
Cissampelos discolor DC. var. *cardiophylla* A. Gray
Cissampelos Cumingiana Turcz.

Local names: *Abodo* (C. Bis.); *bangbáñgau* (Ilk.); *batang-bátang* (Tag.); *gulagulamánan* (Tag.); *hampapáre* (Bis.); *himpapára* (Bis.); *kaláad* (Ilk.); *kalakalamáyan* (Tag.); *kalkaláad* (Ilk.); *kauas* (Sub.); *kuskusipa* (Ilk.); *makabó-o* (Tag.); *malarúto* (Ibn.); *samang* (Bon.); *sampáre* (Bis.); *sansáu* (Tag.); *sincháo-sincháuan* (Tag.); *sinsau-sinsaúan* (Tag.).

This species is common throughout the Philippines, in thickets, at low and medium altitudes. It is pantropic in distribution.

Wehmer (68) records that the roots contain an alkaloid, sepeerine, 0.5 per cent, and cissampeline.

The roots are pounded and thrown into a river or pool to stupefy fish. Burkill (10) reports the use of this plant also as a fish poison in Malaya. He further states that the alkaloid in the root of this plant is identical with that in the drug, *Pareira brava.*

TINOMISCIUM PHILIPPINENSE Diels.

Local names: *Bayáting* (Pamp., Tag.); *kalumpáñgi* (Bag.).

The species is reported from Pangasinan, Tayabas, and Laguna Provinces in Luzon; Biliran; Lanao and Davao Provinces in Mindanao, as growing in forests at low and medium altitudes. It is endemic.

According to Feliciano and Santos (16) the fruits contain picrotoxin.

According to Villadolid and Sulit (64) the fruits are used as a fish poison. They describe the preparation of the poison as follows: The ripe fruits are roasted until they turn coffee-colored; then they are pulverized with earthworms cut into pieces the size of kernel of corn. The mixture is ready as fish poison. In Pansipit River, in Batangas Province, the practice is to mix the powdered fruits with crushed "katang," small fresh-water crabs. The poison is applied by scattering the mixture in a pool of water or in any portion of the river where the water is quiet. Application in the evening is recommended. The stunned fish may be collected early next morning.

CAPPARIDACEÆ

GYNANDROPSIS GYNANDRA (Linn.) Merr.

Cleome gynandra Linn.
Gynandropsis pentaphylla DC.
Pedicellaria pentaphylla Schrank
Sinapistrum pentaphyllum Medic.
Cleome alliacea Blanco
Cleome alliodora Blanco

Local names: *Apoi-apoián* (Tag.); *balabalanóian* (Tag.); *halayá* (P. Bis.); *huláya* (P. Bis.); *tantandók* (Ilk.); *tantandók-a-dadakkel* (Ilk.).

Gynandropsis gynandra is found throughout the Philippines, at low and medium altitudes, occurring as a weed in waste places and often abundant especially near the sea. It is pantropic in distribution.

Planchon and Collin(47) state that the plant yields an acrid, volatile oil, having the properties of garlic or mustard oil.

According to Watt(66) the plant is used as a fish poison.

LEGUMINOSÆ

ALBIZZIA ACLE (Blanco) Merr.

Mimosa acle Blanco
Pithecolobium acle Vidal
Xylia dolabriformis Vidal

Local names: *Akle* (Sbl., Tag., Pamp., Tagb., P. Bis.); *banúyo* (P. Bis.); *kitakíta* (Ilk., Pang.); *lan̄gin* (P. Bis.); *lan̄gip* (Bis.); *mabun̄ga* (Tag.); *sauriri* (Tagb.); *solungkigi* (Tagb.); *tabalan̄gi* (Bis.); *tili* (Sbl.); *tilis* (Sbl.).

The species is found from northern Luzon southward to Palawan and Negros, in forests, at low and medium altitudes. It is endemic.

The bark of this plant is said to be used as a fish poison. It contains saponin.

ALBIZZIA PROCERA (Roxb.) Benth.

Mimosa procera Roxb.
Mimosa coriaria Blanco

Local names: *Achóan* (Ig.); *adáan* (Ilk., Ting.); *adáan-bákir* (Pang.); *adian̄gau* (Tag.); *ayan̄gau* (Tag.); *akleng-párang* (Ilk., Sbl., Tag.); *alalanad* (Tag., Pamp.); *alalan̄gad* (Tag.); *anaplá* (Mang.); *aninaplá* (Tag.); *aninípla* (Tag.); *anitap* (Pamp.); *boak* (Ig.); *dáan* (Ilk.); *darian̄gau* (Tag.); *kálai* (Ting.); *káral* (Ibn., Pang.); *karáil* (Sbl.); *karáol* (Sbl.); *payhod* (Bis.); *payhot* (Bis.); *palatangan* (Ilk.).

This species is found from Cagayan to Batangas Provinces in Luzon; Mindoro and Busuanga, common in thickets, second-

growth forests, parang, etc., at low altitudes, in regions subject to a long dry season. It is also found from India to central China southward to tropical Australia.

The bark of this plant is said to be used as a fish poison. The bark contains saponin. Kalaw and Sacay (33) also report a great amount of saponin in the bark, and a fair amount in the leaves and roots. Howes (31) also records this species as a fish poison in Australia.

ALBIZZIA SAPONARIA (Lour.) Blume.

Mimosa saponaria Lour.
Albizzia tomentella Merr.
Albizzia lucide F.-Vill.

Local names: *Balógo* (Bbo.); *balóyo* (Sul.); *gógo-kásai* (Tag.); *gógong-tokó* (Tag., Pang.); *gúgong-tukó* (Tag.); *gúgong-malatukó* (Tag.); *haunaki* (Bik.); *hinaki* (C. Bis.); *inauaki* (Bis., Bik.); *kogon-toko* (Tag.); *karikir* (Bag.); *katumbal* (Bag.); *malatoko-gugu* (Tag.); *malatukó* (Tag.); *malatukú* (Tag., Pamp.); *marataoka* (Ilk.); *maratéka* (Ilk.); *maratika* (Ilk.); *martíga* (Ilk.); *masugat* (Yak.); *paltauin* (Tag.); *pipi* (P. Bis.); *salang-kúgi* (P. Bis., Sul.); *salang-kúgi* (P. Bis.); *salingígi* (Tag.); *salingkógi* (Tag.); *saling-kúgi* (Bik.); *sologígi* (S. L. Bis.); *salukígi* (S. L. Bis.); *salungígi* (P. Bis.); *siañgingi* (Mbo.); *sankugi* (C. Bis.); *sankugu* (C. Bis.); *saplit* (Ilk.); *siangkúgi* (Mbo.); *tagumtagum* (Mbo.); *tagurarit* (Pang.); *tambíng* (Ig.); *tigian* (P. Bis.); *tanaki* (Bis.); *unaki* (Bik.); *upi* (If.).

A common species in forests, parang, etc., at low and medium altitudes in the Philippines. It is also reported from Indo-China through Malaya to the Moluccas.

According to Kalaw and Sacay (33) the bark is used as a fish poison in the Philippines. They report the presence of both hydrocyanic acid and saponin in the leaves, bark, and roots. Bacon (1) reports that the bark contains one of the saponin glucosides. Wehmer (68) records the presence of saponin and traces of alkaloid in the bark and seeds.

CAESALPINIA PULCHERRIMA (Linn.) Sw.

Poinciana pulcherrima Linn.

Local name: *Caballero* (Sp., Tag.) in all provinces.

This ornamental, which is of very recent introduction into the Philippines, is cultivated throughout the Archipelago. It is widely cultivated and naturalized in the Tropics of both hemispheres.

Although the plant is common here, its use as a fish poison is not known in the Philippines. For our knowledge of its use as a fish poison, we are indebted to Standley, (60) who reports

that in Guatemala the leaves are thrown into the water to stupefy fish.

DERRIS ELLIPTICA (Roxb.) Benth.

Derris elliptica is abundant in thickets along streams, secondary forests, etc., at low and medium altitudes from northern Luzon to Mindanao. The plant is also cultivated for its roots as an insecticide. It is also reported from Chittagong through Malaya to New Guinea and the Bismarck Archipelago.

Brown (8, 9) reports that the roots are used to poison fish in the Philippines. Rumpf, in the Herbarium Amboinense, describes this plant as a fish poison. Burkill (10) and Gimlette (19) describe the preparation of the poison and the method used in fishing in Malaya. Chopra (12) lists this species as a fish poison in India. Gater (18) states that this plant is common piscicide in Malaya.

The method used by the Malays in sea-fishing is described by Wray (69) as follows: The root is pounded or ground fine and mixed with stiff clay and crushed refuse, shrimps or small fish, and the mixture is then made into balls and dried. These balls are thrown into the sea, like ground-bait, and fish eating them become poisoned, rise to the surface, and are caught by the fishermen. In using "tuba," he continues, in rivers and fresh water generally the more usual practice is to pound the roots in water in some form of receptacle, sometimes half-filled canoe, and then empty this at the top of an enclosed portion of the river or stream. Sometimes lime is added after pounding in order to make the milky fluid sink and spread more rapidly when poured into the river. Skeat and Blagden (59) reports that the method of fishing, considered the most effective by the Sakais of Selangor and other Malay pagan tribes, consists in temporarily poisoning small streams and rivers by the use of the sap of the pounded roots of *Derris elliptica*. Ridley (53) states that the plant is often cultivated in Malay Peninsula as a fish poison.

DERRIS PHILIPPINENSIS Merr.

Derris multiflora Benth. var. ? *longifolia* Benth.
Derris multiflora Vidal

Local name: *Upi* (Ig.).

This is an endemic species reported from Luzon in the following provinces: Cagayan, Ilocos Norte, Benguet, Rizal, Laguna, Bataan, Tayabas and Camarines, as growing in thickets and forests, at low and medium altitudes.

Brown(8) reports that the roots of this plant are used as a fish poison in the Philippines.

DERRIS POLYANTHA Perk.

Local names: *Timalang* (Tag.); *tuglí* (Tag.); *tuglón* (Tag.); *tuglún* (Tag.).

This is an endemic species reported from Pampanga, Pangasinan, Laguna, and Batangas Provinces in Luzon, as growing in thickets and secondary forests at low altitudes.

Bacon(1) reports this plant as a fish poison containing a poisonous alkaloid.

Villadolid and Sulit(64) give the following account of the use of this plant as a fish poison. The roots are pounded and then scattered in a pool of water. The procedure is repeated as many times as is deemed necessary in order to extract as much as possible the juice present in the roots. It has been found by experience that a bundle of roots 50 centimeters long and 10 to 15 centimeters in diameter when thoroughly pounded will be sufficient to treat a pool one meter deep and about 10 meters wide. It is said to be more effective in salt water than in fresh water. The poison is found to take effect almost immediately after application.

DERRIS SCANDENS (Roxb.) Benth.

Dalbergia scandens Roxb.
Galedupa frutescens Blanco
Deguelia timoriensis Taub.

Local names: *Lapak* (Bik.); *malasága* (Tag.).

This species is common in thickets and secondary forests at low and medium altitudes, throughout the Philippines. It is also found in India to southern China through Malaya and tropical Australia.

Despite the abundance of the plant in the Philippines, it has not been reported as being used for poisoning fish. Chopra(12) lists this species as a fish poison in India.

DERRIS TRIFOLIATA Lour.

Dymock, Warden, and Hooper(14) state that a proximate analysis of the bark revealed the presence of two resins and an acrid glucoside allied to saponin. According to Pammel(45) the poisonous principle is derrin.

Burkill(10) quotes Blume (1825), who mentions this plant as a fish poison. This was confirmed by an ichthyologist, Bleeker, in 1858. Kalaw and Sacay(33) report this vine as poisonous and useful as an insecticide and as a fish poison. While

Brown(8) mentions this plant as a fish poison, he believes it to be poor insecticide. Chopra(12) includes this species also as a fish poison in India. Roth(54) describes the method in preparing this plant as a fish poison in Cooktown, Queensland, as follows: The stems are hammered on a stone or log, put into bundles and roasted, and finally thrown into the water which it renders more or less soupy. In Tully River the leaves are rather employed, especially for eels.

According to Hamlyn-Harris and Smith(26) *Derris uliginosa,* a synonym of this species, is one of the most effective and rapid fish poisons in Queensland. They say that on the O'Connell River, the plant is disintegrated, placed in nets, and infused into the water of small lagoons. The method used is as follows: The vine is cut up into two-foot lengths, sticks about a finger's thickness being preferred. These are beaten and bruised and handfulls therefore taken and thrown into the water, where they are again beaten and worked out. Fish quickly stupefy, and rising to the surface, are easily caught or speared.

ENTADA PHASEOLOIDES (Linn.) Merr.

Lens phaseoloides Linn.
Mimosa entada Linn.
Entada scandens Benth.
Adenanthera gogo Blanco
Entada pursaetha DC.
Mimosa Blancoana Llanos

Local names: *Balúgo* (Tag., Pamp.); *barúgo* (S. L. Bis.); *bayógo* (C. Bis., Tag.); *balónos* (Bis.); *dípai* (Ig.); *gógong-bákai* (Pamp.); *gógo* (Tag., Bik., Tagb., P. Bis.); *gúgo* (Tag.); *gúgu* (Tag.); *késsing* (Ibn.); *lipai* (Ilk.); *tamayan* (Bag.).

Gógo is pantropic in distribution. It is common in forests at low and medium altitudes throughout the Philippines.

The common gógo, according to Bacon,(1) is one of the plants used in the Philippines as a fish poison, and it owes its efficacy to its saponin content. A saponin solution of 1 to 20,000 was prepared by him, and three small fish placed in it. The fish soon became stupefied, floating about without motion on the surface of the water, and all died within two or three hours. The fish poison is usually prepared with considerable ceremony by the headmen of a village, the various ingredients being pounded together and then thrown into the stream or pool. The plants are often mixed with earth and rocks, the intention being to sink the noxious plants so that all parts of the water may be poisoned. Very soon small fish begin to float on their sides

on the surface of the water, while the larger ones move about slowly in a stupefied and helpless manner. The natives then rush into the water and kill and catch all they can. Bacon isolated saponin, which gives a crystalline sapogenin.

Kalaw and Sacay(33) report that the bark and leaves are crushed and put in ponds and streams to poison fish. Chopra(12) lists this plant as a fish poison in India. Watt and Breyer-Brandwijk(67) record this plant as a fish poison in South Africa.

MILLETTIA MERRILLII Perk.

Millettia xylocarpa Naves
Millettia caerulea F.-Vill.

Local names: *Balók* (Tag.); *balok-balók* (Tag.); *bani* (Ilk., Pamp.); *malabai* (Pamp.); *pañgardísen* (Ilk.).

This is an endemic species reported from Cagayan to Bataan and Rizal Provinces in Luzon, Mindoro, and Negros, growing in thickets and secondary forests, at low and medium altitudes.

The bark, roots, and leaves of this plant are used by fishermen particularly of Batangas and Bataan Provinces as fish poison. These parts are pounded and thrown into the water. The poison is considered powerful. The parts herein mentioned contain considerable amount of saponin.

PITHECOLOBIUM ELLIPTICUM (Blume) Hassk.

Inga elliptica Blume
Pithecolobium fasciculatum Benth.

Local names:: *Bugas* (P. Bis.); *salangkógi* (C. Bis.); *tabid-tabid* (Sul.).

The distribution in the Philippines of this species is limited only to Palawan, Panay, Negros, and Mindanao. It is also found in Malay Peninsula and Archipelago.

The bark is sometimes gathered and pounded and thrown into the water to poison fish in certain localities in Mindanao. Whether it is a saponin or a tannin responsible for the poison could not be ascertained. Burkill,(10) quoting Heyne,(29) says that the bark is used in Java as a fish poison.

PONGAMIA PINNATA (Linn.) Merr.

Cytisus pinnatus Linn.
Robinia mitis Linn.
Galedupa indica Lam.
Dalbergia arborea Willd.
Pongamia glabra Vent.
Galedupa maculata Blanco

Pongamia mitis Merr.
Galedupa pinnata Taub.
Caju pinnatum O. Kuntze
Pterocarpus flavus Lour.

Local names: *Bagnéi* (Ibn.); *balikbálik* (Tag.); *balubalu* (Sul.); *bálok* (Tag.); *balok-bálok* (Tag., Bik.); *balu-bálu* (Yak.); *baluk-báluk* (C. Bis.); *balotbalot* (Tag.); *balutbalut* (Mag.); *bani* (Tag., Ilk., Sbl., Pamp.); *banít* (Tag.); *baobáo* (Mbo.); *bayog-báyok* (Tag., C. Bis.); *bayok-báyok* (C. Bis.); *butong* (Bis.); *kadel* (Tag.); *magit* (Mag.); *malok-balok* (P. Bis.); *marok-bárok* (Bik., S. L. Bis.); *maruk-báruk* (C. Bis.); *marobáhai* (Tagb.).

This is a common species reported throughout the Philippines, along the seashore, and near borders of lakes. It is also reported from Mascarene Island, tropical Asia, across Malaya to Australia and Polynesia.

Dymock, Warden, and Hooper(14) report that the bark contains a bitter alkaloid, also an acid resin. The seeds have bitter taste and their bitter principle appears to reside in a resin and not in an alkaloid.

The bark and the seeds are used as a fish poison in many localities in the Philippines. It has been also reported elsewhere as a useful plant for poisoning fish. Burkill(10) reports that the seeds are said to kill fish. Fishing by this means is reported also from Australia and Madeira. The roots are said to be more potent, are roasted, pounded and thrown into the water to be fished. It is also recorded as a fish poison in Australia by Howes.(31)

TEPHROSIA CANDIDA (Roxb.) DC.

This species has been introduced recently into the Philippines as a cover crop. We have no knowledge of its use in the Philippines as a fish poison. However, in Africa Howes(31) reports that the genus *Tephrosia* figures conspicuously among African fish-poison plants. The toxic properties of various species have been investigated, and tephrosin has been isolated. Gamble(17) records this species as a fish poison in eastern Bengal and Burma, the bark and the leaves being chiefly used.

ERYTHROXYLACEÆ

ERYTHROXYLUM CUNEATUM (Wall.) Kurz.

Ficus cuneata Wall.
Urostigma ? cuneatum Miq.
Erythroxylum burmanicum Griff.

Local names: *Baransiágau* (Ilk.); *manambo* (Bik.); *sáleng* (Tag.); *salñgen* (Ilk.).

The species has been reported from the following provinces of Luzon: Ilocos Norte, Ilocos Sur, Bulacan, Rizal, and Camarines, growing in secondary forests, especially on limestone formations at low and medium altitudes. It is also reported from Tenasserim, Malay Peninsula, Sumatra, and Java.

According to Kalaw and Sacay (33) the plant is used as a fish poison in Bulacan Province.

RUTACEÆ

AEGLE MARMELOS Correa.

Local names: *Bael, Bengal quince, bhel, elephant's apple, maredoo* (Engl.).

Bael has been recently introduced into the Philippines, and cultivated for its edible fruits.

Chopra (12) states that bael contains a bitter principle and a balsamic principle resembling Balsam of Peru.

Heyne (29) states that the bark is used in Celebes to make a fish poison.

ZANTHOXYLUM TORVUM F.-Muell.

Zanthoxylum glandulosum T. & B.
Fagara torva Eugl.
Fagara Warburghii Perk.

Local name: *Kayatana* (Tag.).

Zanthoxylum torvum is found in Tayabas and Isabela Provinces in Luzon, and in Leyte and Mindanao, in forests and thickets at low and medium altitudes. It is also reported from Java, Moluccas, and tropical Australia.

In the Philippines the vine is pounded thoroughly and inserted in the holes. It poisons eels and mudfish (*dalag*).

MELIACEÆ

DYSOXYLUM DECANDRUM (Blanco) Merr.

Turraea decandra Blanco
Turraea virens Blanco
Dysoxylum amooroides Miq.
Dysoxylum Blancoi Vidal
Dysoxylum salutare F.-Vill.

Local names: *Agáru* (Pang.); *agúiu* (Pamp.); *ananang-tang* (Bik.); *bakúgan* (Bik.); *bundúgon* (Bik.); *buntóg* (Bik.); *buntógan* (Bik.); *bong-liu* (Bik.); *basiloág* (Ilk.); *bolong-tambang* (Bik.); *ikuo* (Tag.); *igiu* (Tag., Pamp.); *hugiug* (Tag.); *malaaduas* (P. Bis.); *manangtang* (Bik.); *malabangau* (Pamp.); *makasisi* (Bik.); *malabaga* (Pamp.); *palo-nambo-bokag* (Bik.); *paluahan* (P. Bis.); *pamatágin* (Ibn.); *pasiloág* (Ilk.); *ta-diang-kalabáu* (Tag.); *tauing-tauing* (Mbo.); *taliktan* (Tag., Pamp.).

A common species in thickets and forests at low altitudes throughout the Philippines. It is also reported from Java to New Guinea.

According to Kalaw and Sacay(33) the plant is a common fish poison in Batangas Province.

MELIA AZEDARACH Linn.

Paraiso is cultivated in larger towns for its fragrant flowers, but nowhere naturalized. It was introduced from China.

Watt and Breyer-Brandwijk(67) record that from the bark a bitter substance, which is either a neutral principle or an alkaloid, was isolated.

We have no information that the plant is used as a fish poison in the Philippines. According to Standley(60) the bark is said to be used in some regions of Mexico for stupefying fish.

EUPHORBIACEÆ

ALCHORNEA PARVIFLORA (Benth.) Muell.-Arg.

Stipellaria parviflora Benth.
Acalypha tiliaefolia Vidal
Alchornea tiliaefolia Ceron
Alchornea sicca Pax & Hoffm.

This endemic species has been reported from Bulacan and Rizal Provinces in Luzon, Palawan, Leyte, and Negros, as growing in thickets and secondary forests, at low and medium altitudes.

In Bulacan Province it is said that all parts of the plant are used as a fish poison. These are pounded and then thrown into the water. All parts contain saponin.

ALCHORNEA SICCA (Blanco) Merr.

Excoecaria sicca Blanco
Croton drupaceum Blanco
Alchornea mollis F.-Vill.
Alchornea philippinensis Pax & K. Hoffm.

Local name: *Balánti* (Tag.).

The species is endemic in the Philippines, having been reported from Pangasinan, Pampanga, Rizal, and Laguna Provinces, and even in Manila, growing in thickets along small streams, at low altitudes.

According to Brown(8) the leaves and fruits are used for poisoning fish. Kalaw and Sacay(33) also report the use of the leaves and fruits for poisoning fish. Hydrocyanic acid is pre-

sent in the leaves; absent in the bark and roots; saponin is present in all parts of the plant.

CROTON TIGLIUM Linn.

Croton camaza Perr.
Croton glandulosum Blanco
Croton muricatum Blanco
Tiglium officinale Klotz.

Local names: *Gasi* (Sul.); *kamágsa* (Bik.); *kamaísa* (Tag.); *kamandag* (Bis.); *kamausa* (Tag.); *kásla* (Sul.); *lutung-sira* (Bik.); *makaísa* (Tag.); *makásla* (P. Bis.); *malapai* (Sul.); *salígau* (Ilk., Ibn.); *túba* (Ilk., Bik., Tag., S. L. Bis.); *tuba-túba* (Bik., P. Bis.); *tubang-kamaísa* (Tag.); *tubang-makaísa* (Bik., Tag.); *tubang-pasíti* (Bik.); *túbli* (C. Bis.); *túkbu* (If.).

This species is of prehistoric introduction from Malaya. It is common throughout the Philippines in and about towns, usually planted, sometimes naturalized. It is also reported from India to New Guinea. It is universally used for poisoning fish.

Tavera(63) first reported the use of the fruits by Filipinos to intoxicate fish in slow-running streams and in pools. According to Bacon(1) the fruit is one of the favorite fish poisons used in the Philippines. He reports that the fruits contain the very poisonous toxalbumin, crotin, which is similar to the well-known ricin and abrin. Persons who eat fish poisoned with this plant were not disturbed, although it is considered dangerous to drink water which contains any quantity of it.

Brown(8) reports that the crushed leaves are used for poisoning fish. Guerrero(25) also mentions this plant as a fish poison. Kalaw and Sacay(33) state that the plant has no use except as a fish poison, for which purpose the leaves are used. Howes(31) says that this species is used as a fish poison in Celebes. The plant is used as follows: The fruits are ground with strong-smelling root of an aroid, *Homalonema rubra* Hassk., and scattered upon the surface of the water. Gimlette(19) records that the pounded ripe fruits of this plant are used by the natives of Java and Dyaks of Borneo to poison fish.

EUPHORBIA NERIIFOLIA Linn.

Euphorbia ligularia Roxb.
Euphorbia pentagona Blanco
Euphorbia trigona Merr.

Local names: *Bait* (Pamp., Tag.); *karimbuáya* (Ilk.); *lengua de perro* (Sp.); *soro-sóro* (Tag.); *sorog-sórog* (Pamp., Tag.); *sudusúdu* (P. Bis.).

The plant is cultivated in gardens in Manila and in some large towns; doubtless an introduced species. It has been re-

ported also from India to Malaya, probably introduced in the latter region.

Nadkarni(42) reports that the following constituents were isolated from the milky sap: euphorbon, resin, gum, cauotchouc, calcium of malate, etc.

The Igorots use the bark and the leaves to poison fish. According to Kalaw and Sacay(33) this species is one of the commonest fish poisons, the leaves being employed for the purpose.

EUPHORBIA TIRUCALLI Linn.

Local names: *Bali-bali* (P. Bis.); *consuelda* (Sp.); *katuit* (Tag.); *konsuérda* (Tag.); *gaton* (Ig.); *putputud* (Ig.); *solda-solda* (C. Bis.); *suelda-con-suelda* (Bik.); *suérda* (Tag.).

This is an introduced species in the Philippines; a native of Africa, now planted in most tropical countries. It is occasionally planted here in gardens, but apparently nowhere spontaneous.

According to Henke(28) euphorbon was isolated in handsome needles, together with 4 per cent cauotchouc, from the milky sap.

It is known that the plant is being used in the Philippines as a fish poison. Chopra,(12) however, lists this species as a fish poison in India. Greshoff,(22) quoting Doctor Boa, says that the milky juice is used for poisoning fish in Goa.

EUPHORBIA TRIGONA Haw.

Local names: *Suda-súda* (P. Bis.); *túba* (Bon.).

The plant is rather common throughout the Philippines, in thickets and on limestone cliffs, usually along the seashore. It is also reported from India to Malaya.

Henke(28) isolated from the milky sap 35 per cent euphorbon.

The bark is pounded first, and then thrown into the water to stupefy fish. The catch is made when the fish float on the surface. Heyne(29) quotes Boorsma, who states that the latex is poisonous, but the plant is much less poisonous than its close allies, and only stupefies fish after long contact.

EXCOECARIA AGALLOCHA Linn.

The bark is the part of the plant used in poisoning fish. This is pounded and thrown into the water. Kalaw and Sacay(33) also report that the leaves and stem of this plant are used as a poison in New Caledonia.

FLUGGEA VIROSA (Roxb.) Baill.

Phyllanthus virosus Roxb.
Xylophylla obovata Willd.
Fluggea obovata Wall. ex F.-Vill.
Fluggea microcarpa Blume
Cicca pentandra Blanco
Securinega microcarpa Muell.-Arg.
Securinega obovata Muell.-Arg.
Fluggea leucopyrus F.-Vill.
Securinega ovata Vidal

Local names: *Arusit* (Ilk.); *barasiksik* (Ilk.); *barsit* (Ig.); *barsik* (Ilk.); *barusík* (Ilk.); *bayasit* (Tag.); *boiset* (Tag.); *botolan* (Tag.); *bugbugutut* (Ig.); *kabukabukas* (Mag.); *magaspáng* (P. Bis.); *máluuit* (Ibn.); *tulitañgalong* (P. Bis.).

This species is common throughout the Philippines in dry thickets, at low and medium altitudes. It is also reported from tropical Africa through India to China and Malaya to tropical Australia.

According to Kirtikar and Basu(35) the bark contains 10 per cent tannic acid and an alkaloid.

Brown(8) reports that the bark is used to poison fish. Chopra(12) also mentions the plant as a fish poison in India.

HOMALANTHUS FASTUOSUS (Linden) F.-Vill.

Mappa fastuosa Linden
Dibrachion fastuosum Regel.
Carumbium fastuosum Muell.-Arg.

Local names: *Balánti* (Ilk., Tag., Bis.); *bóta* (Tag.); *bota-bóta* (Tag.); *botinag* (Ig.); *bubúta* (Ig.); *búta* (Tag.); *buta-búta* (Tag., Ig.); *put-púta* (Ig.); *tanugtug* (Iv.).

The species is common in thickets, old clearings, etc., mostly above an altitude of 750 meters, ascending to 2,000 meters. It is endemic in the islands, and has been reported from Batan Islands, Luzon (Abra, Bontoc, Lepanto, Benguet, Nueva Vizcaya, Tayabas, Laguna, Rizal, Sorsogon); Mindoro; Catanduanes; Panay; and Mindanao (Lanao).

Brown(8) reports that the leaves of this plant are used for poisoning fish. Kalaw and Sacay(33) also mention this plant as a fish poison; and they state that the leaves are crushed and placed in streams. Saponin is present in all parts.

JATROPHA CURCAS Linn.

The latex from the bark is used to stupefy fish. This is done by pounding the bark and thrown into the water. Kalaw and Sacay(33) add also that the whole leaves and stems are poisonous to fish.

JATROPHA MULTIFIDA Linn.

Jatropha janipha Blanco

Local names: *Maná* (Sp.); *tubang-amerikáno* (Bik.).

The species is introduced from tropical America. It is planted as an ornamental in Manila and large towns.

Wehmer(68) records that the seeds contain a bitter principle; the leaves with saponin; and the bark with a very toxic alkaloid, jatrophin.

Brown(8) lists this plant as a fish poison in the Philippines.

MALLOTUS PHILIPPENSIS (Lam.) Muell.-Arg.

Croton philippense Lam.
Echinus philippinensis Baill.
Rottlera philippinensis Scheff.
Rottleria manilensis Klotz. ex Pax & Hoffm.

Local names: *Apúyot* (Sul.); *banató* (Ibn., Ig., Tag.); *buás* (Ilk.); *darandáng* (Tag.); *panagisen* (Ibn.); *panagisian* (Neg.); *panagisien* (Ibn., Klg.); *pangaplasin* (Ilk.); *pikal* (Sbl.); *sala* (Tag., Bis.); *tafú* (Ibn.); *tagusála* (P. Bis.); *tutúla* (Tagb.).

Banató is common in thickets and second-growth forests at low altitudes, throughout the Philippines. It is also reported from India to southern China and Formosa, southward to New South Wales.

Wehmer(68) records that kamala resin contains the yellow rottlerin, also mallotoxin and kamalin.

The plant is well known here for its dye. In the Malay Peninsula, India, and Burma it is also known as a dye and a medicinal plant. It is not known as a fish poison in the Philippines. Bartlett(4) calls attention to the use in Sumatra of the name "tuba" for it, as if it were used there as a fish poison.

PHYLLANTHUS NIRURI Linn.

Phyllanthus carolinianus Blanco
Phyllanthus kirganelia Blanco
? *Kirganelia pumila* Blanco
? *Phyllanthus pumilus* Muell.-Arg.

Local names: *Kurukalunggái* (Bik.); *malakirumkirum* (S. L. Bis.); *n̄gingihel* (If.); *sampasampalúkan* (Tag.); *San Pedro* (P. Bis.); *surusampálok* (Bik.); *talikód* (Ilk.); *taltalikod* (Ilk.); *turutalikod* (Bik.).

This is a common weed throughout the Philippines. It is pantropic in distribution, but probably introduced into the New World.

Dymock, Warden, and Hooper(14) quote Ottow [8] who isolated the bitter principle, phyllantin.

According to Burkill(10) the bitter substance is said to poison fish in Malaya. Kalaw and Sacay(33) say that saponin is present in the stem. It acts as a fish poison.

MISCELLANEOUS EUPHORBIACEAE

According to Howes(31) a large number of other euphorbiaceous plants belonging to genera *Securinega, Macaranga,* and *Sapium* are used as a fish poison in Asia.

BUXACEÆ

BUXUS ROLFEI Vidal.

Local names: *Malagaápi* (Tag.); *piukbanau* (Tag.); *sarapuyau* (Neg.); *yarang-yárang* (Neg.).

This is an endemic species reported from Bataan, Rizal, Pampanga, and Tayabas Provinces in Luzon; Sibuyan; Palawan; and Surigao Province in Mindanao, growing in primary forests, at low and medium altitudes.

According to Brown(8) the fruits of this plant are dried and finely cut, and then scattered on water as a fish poison.

SAPINDACEÆ

DODONAEA VISCOSA (Linn.) Jacq.

Ptelea viscosa Linn.
Dodonoea angustifolia Linn.

Local names: *Dumánai* (Ig.); *haguiui* (Tag.); *kalapínai* (Tag.); *kasirag* (Sbl.); *lugad* (Kuy.); *tabau* (Tag.); *takud* (C. Bis.); *tubu-tubu* (C. Bis.); *sagása* (P. Bis., C. Bis.).

A pantropic weed rather common throughout the Philippines, along the seashore, in regions subject to a pronounced dry season, extending inland and ascending to 2,000 meters.

Burkill(10) quotes Ghose [9] who found an alkaloid, a glucoside, and resins as well as tanning in the leaves. Wehmer(68) quotes Greshoff [10] who reported the presence of saponin.

Watt and Breyer-Brandwijk(67) quote Pammel who says that this plant is used as a fish poison. While the species is rather common in the Philippines, it is not recorded as a fish poison.

[8] Mederl. Tijdschr. Pharm. **3** (1891) 126, 160.
[9] Ind. Forester **59** (1933) 78.
[10] Apoth.-Ztg. (1893) 589.

GANOPHYLLUM FALCATUM Blume.

Ganophyllum obliquum Merr.

Local names: *Arañgan* (Ilk.); *arañgin* (Ilk.); *bagusalai* (C. Bis.); *gógo* (Ilk., Ibn.); *gogolíñgin* (Pamp.); *gugo* (Tag., P. Bis.); *guguláñgin* (Pamp.); *gogoñglángil* (Tag.); *halas* (P. Bis.); *láñgin* (Tag.); *odo* (Tag.); *palumpung* (Tag.); *panda-panda* (Tag.); *pararan* (Bag.); *salñgen* (Ilk.); *tahuyai* (P. Bis.); *tugabi* (Tag.); *tulibas* (Tag.).

This is a common species in dry forests, at low and medium altitudes, throughout the Philippines. It is also reported from Andaman Islands, Java, New Guinea, and northern Australia.

Bacon(1) reports this plant as another fish poison containing saponin. The bark contains no alkaloids, a considerable amount of resin, and 7.2 per cent of saponin. The physiological behavior of saponin from this plant is very interesting, it being more irritating than the one from *Entada phaseoloides*. The action of this saponin on fish is apparently the same as that of the one from *Entada phaseoloides*. These saponins are particularly advantageous as fish poisons, because no harm will come from eating the fish. Kalaw and Sacay(33) also mention this plant as a fish poison.

HARPULLIA ARBOREA (Blanco) Radlk.

Ptelea arborea Blanco
Seringia lanceolata Blanco
Blancoa arborea Blume
Harpullia Blancoi F.-Vill.
Harpullia cupanioides F.-Vill.
Harpulia imbricata Thwaites

Local names: *Abúyan* (Ilk.); *ambuyoán* (Ilk.); *antatúba* (Neg.); *bogna* (Bag.); *dalirugái* (Ibn.); *dulio* (Sml.); *dulía* (Mag., Mbo.); *huás* (P. Bis.); *kayaskas* (Ilk.); *magalad* (Tagb.); *magalat* (Bik.); *magantimus* (Mag.); *malatúbas* (Bik.); *maramblág* (Ibn.); *mama-an* (Tagb.); *oás* (Ibn., Ilk., Tag.); *uás-na-puráu* (Ilk.).

This species is common in thickets and secondary forests, at low and medium altitudes, throughout the Philippines. It is also reported from India through Malaya to the Solomon Islands.

Greshoff(22) reports the presence of saponin.

According to Brown(8) the bark of this plant is chopped fine and put in fresh-water streams to kill fish. Guerrero(25) states that the bark contains an active substance which stupefies and kills fish. Saponin is said to be present in the leaves, bark, and roots.

SAPINDUS SAPONARIA Linn.

Quassia tricarpa Blanco
Sapindus Forsythii Turcz.
Sapindus Turczaninowii Vidal

Local names: *Amugáen* (Ilk.); *kasibag* (Ilk.); *kasábai* (Ilk.); *katíkis* (Tag.); *katigis* (Tag.); *kasiben* (Ilk.); *kasíbeng* (Ibn., Ilk.); *kusibeng* (Ilk.); *malahito* (Tag.); *malapalitpit* (Pamp.); *palikpík-hitó* (Tag.): *tika-tiká* (Tag.); *tikas-tikás* (Tag.); *tikis-tíkis* (Tag.).

The species is locally common in secondary forests, at low and medium altitudes. It has been reported from the following provinces of Luzon: Cagayan, Ilocos Norte, Ilocos Sur, Abra, La Union, Pangasinan, Nueva Ecija, Zambales, Pampanga, Bataan, Rizal, and Laguna; and Cotabato Province in Mindanao. It is pantropic in distribution.

The seeds when pounded and thrown into streams cause death of fish. The bark has also been used and is reported to contain saponin. Macfadyen(38) reports that, bruised or pounded, and thrown into ponds of water, the bark intoxicates and kills any fish that may be found there. It is said that the fruit is used in Mexico(60) also for stupefying fish. The fruits contain as much as 37 per cent saponin.

RHAMNACEÆ

COLUBRINA ASIATICA (Linn.) Brongn.

Ceanothus asiatica Linn.
Rhamnus carolinianus Blanco

Local names: *Kabatíti* (Tag.); *kayaskás* (Ilk.); *paria* (Bag.); *palíalaut* (Sul.); *parid-lalud* (Sul.); *uatitik* (Tag., Bis.).

This species grows along the seashore and borders of tidal streams, throughout the Philippines. It is also reported from India to Africa, through Malaya to Australia and Polynesia.

According to Heyne(29) the bark contains saponin.

The fruits are used as fish poison.(25)

ZIZYPHUS JUJUBA (Linn.) Lam.

Rhamnus jujuba Linn.
Zizyphus mauritiana Lam.

Local names: *Manzanas, manzanitas* (Sp.).

The manzanas, or manzanitas, as is universally known in the Philippines, is introduced from tropical Asia. It is widely scattered in cultivation and scarcely naturalized here.

According to Nadkarni(42) the bark contains much tannin, and a crystallizable principle, ziziphic acid.

Howes(31) reports that this species is a reputable fish poison. We have no record in the Philippines of its use as a fish poison.

MALVACEÆ

THESPESIA POPULNEA (Linn.) Soland.

Hibiscus populneus Linn.
Thespesia macrophylla Blume
Thespesia banalo Blanco

Local names: *Balu* (Sul.); *banág* (Kuy.); *banágo* (Tag., P. Bis.); *banágo-pulá* (Tag.); *banálo* (Tag.); *banáro* (Pang.); *baót* (Sul.); *iden* (Ting.); *tuba-túba* (Bik.); *válo* (Iv.).

While this species is common throughout the Philippines along the seashore, it has not been reported as a fish poison. The plant is pantropic in distribution.

Hamlyn-Harris and Smith(26) report that the plant is used as a fish poison, and that they have demonstrated its ability to cause stupefaction and death of fish at higher concentrations.

STERCULIACEÆ

KLEINHOVIA HOSPITA Linn.

Kleinhovia serrata Blanco
Grewia Meyeniana Walp.

Local names: *Apung-ápung* (Sul.); *balansi* (Mang.); *bantana* (C. Bis.); *bignon* (Ilk.); *biknong* (Ilk.); *biluan* (P. Bis.); *binong* (Ilk.); *bitanag* (C. Bis., Mbo.); *bitnong* (Ilk.); *bitnung* (Ilk.); *butnong* (Ilk.); *hunung* (Ilk.); *hamitanágo* (Bik.); *lapnis* (C. Bis.); *marakápas* (Ilk.); *pampas* (Ilk.); *panampat* (Pamp.); *táag* (Tag.); *tagnág* (Chab.); *tamanág* (Bag., Mag.); *tanág* (Tag., Bik., S. L. Bis.); *tanák* (Tag.); *tañgá* (Tag.); *tolok-tok* (Ilk.); *unapong* (Sul.).

A characteristic tree of thickets, second-growth forests, and deserted clearings, throughout the Philippines. It is also reported from India to tropical Africa and Malaya.

Brown(8) and Guerrero(25) report that in the Island of Marinduque the bark and leaves of this plant are used to poison eels.

PTEROSPERMUM DIVERSIFOLIUM Blume.

Pterospermum hastatum Blanco
Pterospermum acerifolium Rolfe

Local names: *Bagud* (Tag.); *bayóng* (Tag.); *báloi* (Ilk.); *balaibáyan* (Sbl.); *bároi* (Neg., Ilk.); *bayóg* (Tag., Bik., Pamp., P. Bis.); *barog-bayóg* (Chab.); *bayóng* (Tag.); *bayók* (Tag., Bik., P. Bis.); *bayúg* (Tag., Sul.); *bayúk* (Tag.); *dibual* (Yak.); *kabislak* (Sul.); *malibayo* (Tag.); *rayók* (Tagb.); *taliñgauan* (Sbl.).

This species is common in forests, at low and medium altitudes, throughout the Philippines. It is also reported from Indo-China, Malay Peninsula, Sumatra, Borneo, Java, and the Moluccas.

The bark of the root is said to act as a fish poison in Malaya.(10)

THEACEÆ

TERNSTROEMIA TOQUIAN (Blanco) F.-Vill.

Llanosia toquian Blanco
Ternstroemia penangiana Vidal
Ternstroemia lobbiana Pierrer
Taonabo toquian Merr.

Local names: *Bigag* (Tag.); *bikag* (Tag.); *boalau* (Mbo.); *debaak* (Ilk.); *garamansatai* (Tag.); *malapuyau* (Tag.); *sambinuluka* (Sbl.); *tabak* (Ilk.); *tokian* (Tag.).

This species is reported growing in primary forests at medium altitudes, in most provinces and islands of the Philippines. It is also known from Celebes.

According to Brown(8) the fruits and the bark of this plant are used for poisoning fish.

GUTTIFERÆ

CALOPHYLLUM INOPHYLLUM Linn.

This species is a characteristic strand tree, common throughout the Philippines, along the seashore. It is also reported from India to tropical East Africa through Malaya to Polynesia.

Richmond and del Rosario(51) report that the oil from the kernels contains a poisonous resin.

The leaves are used for poisoning fish. Both hydrocyanic acid and saponin have been found in the leaves, bark, and roots.(33)

FLACOURTIACEÆ

PANGIUM EDULE Reinw.

It is said that the bark is used as a fish poison in certain localities in the Philippines. The poisonous active principle of this tree is hydrocyanic acid, which is contained in large quantities in the fruits, but unlike cassava, they are edible when properly cooked. The seeds from the young fruits are toxic and not edible. According to Gimlette(19) the bark of this tree is used also as a fish poison in Malaya. Tavera(63) mentions that on account of the narcotic properties of the plant, in Java the bark is used to intoxicate fish.

LECYTHIDACEÆ

BARRINGTONIA ACUTANGULA (Linn.) Gaertn.

Eugenia acutangula Linn.
Botryoropis luzonensis Presl
Strayadium luzonense Miers.
Barringtonia luzonensis Rolfe
Barringtonia reticulata Miq.

Local names: *Apaling* (Ig.); *himbabalód* (P. Bis.); *kalambuáya* (Ilk.); *latuba* (Ibn.); *pútad* (Tag.); *pútat* (Tag.); *pútat* (Tag., Pamp., Bik.); *sakó* (Mbo.); *sakú* (Mbo.); *topuk* (Mag.); *túba* (Tag., Ibn.).

This species is found growing in thickets and forests, at low and medium altitudes, from northern Luzon to Mindanao and Palawan, in most islands and provinces. It is also reported from India through Malaya to tropical Australia.

According to Nadkarni(42) the active principle is allied to saponin. Chopra(12) mentions the presence of glucoside-saponin, barringtonin.

According to Brown(8) the bark of this tree is used as fish poison. Howes(31) records the use of the pulpy fruits of this species as a fish poison. Chopra(12) lists this species as a fish poison in India. Watt(66) also mentions that the bark is used to stupefy fish in most parts of India.

BARRINGTONIA ASIATICA (Linn.) Kurz.

Mammea asiatica Linn.
Barringtonia speciosa Forst.
Agasta asiatica Miers.
Butonica Rumphiana Miers.

Local names: *Balubitóon* (P. Bis.); *bitón* (Bik.); *bitóon* (C. Bis.); *bitung* (Bis.); *botón* (Tag.); *botóng* (Tag., Bik.); *botong-bótong* (Bik.); *butón* (Bik., Chab.); *lugo* (Ibn.); *motong-bótong* (Bik.); *vutón* (Iv.).

This is a common tree growing along the seashore throughout the Philippines. It is also reported from tropical Asia to Polynesia.

Wehmer(68) records that the seeds contain a glucoside, barringtonin.

According to Villadolid and Sulit(64) the bark which is reddish grey is used for poisoning fish. A sufficient quantity of bark, preferably taken from a mature tree, is cut into small pieces, which are then cominuted and mixed with earth in a wooden mortar. The proportion is about one part of earth to three parts of bark. The quantity of bark to be used depends upon the size of the pond to be poisoned. The mixture is put in a gunny sac; a half-sacfull has been found by ex-

perience to be sufficiently strong to kill fish in a pond of about a meter deep and eight meters in diameter. The time of application of the fish poison has been found to be most satisfactory at early dawn; then by six o'clock in the morning the stunned fish may be collected from the pool thus treated.

Brown(8) reports also that the bark and fruits are used as fish poison. Guerrero(25) mentions that the fruits are employed to stupefy fish. Safford(56) reports the use of this plant in Guam for catching fish. He states that the fruits are pounded into a paste, inclosed in a bag, and kept overnight. The time of an especially low tide is selected, and bags of the pounded fruits are taken out on the reef the next morning and sunk in certain deep holes. The fish soon appear on the surface; and the natives scoop them in nets, spear them, or jump overboard and catch them with their hands, sometimes even diving for them. Watt(66) also mentions the plant as useful in India to stupefy fish without killing them.

BARRINGTONIA RACEMOSA (Linn.) Blume.

Eugenia racemosa Linn.
Menichea rosata Sonn.
Barringtonia stravadium Blanco
Butonica rosata Miers.

Local names: *Kasouai* (Mbo.); *kutkut-timbalon* (Sul.); *nuling* (C. Bis.); *paling* (Ibn.); *pótat* (Tag.); *pútad* (Tag.); *pútat* (Tag., Bik., S. L. Bis., P. Bis., Sul., Mag.); *tuba-túba* (C. Bis.).

This is a common species growing throughout the Philippines, in most or all islands and provinces, in thickets, damp places, along the seashore, streams, etc., at low altitudes. It also occurs in India to Malaya and Polynesia.

Burkill(10) reports that the bark contains tannin.

According to Brown(8) the bark of this plant is put in streams to poison fish. This species has also been reported to have been used by the natives of the Mitchell River, northern Queensland, as a fish poison, by Howes(31) and by Palmer.(44) They state that the bark is cut into small pieces and severely pounded between stones before being placed in the water. Roth(54) gives the following account of this species as a fish poison in northern Queensland. The bark is hammered between stones until it gets quite spongy, and then taken into the water, where it is rubbed with the hands. Fish are stupefied in about a quarter of an hour. Dymock, Warden, and Hooper(14) quote Ainslie, who states that in Java and Ternate the seeds are used for intoxicating fish.

ARALIACEÆ

POLYSCIAS NODOSA (Blume) Seem.

Aralia nodosa Blume
Paratropia nodosa DC.
Aralia umbraculifera Roxb.
Aralia pendula Blanco
? *Polyscias acuminata* Vidal

Local names: *Bias-bias* (Tag., Bis.); *bingliu* (Tag., Bis.); *bonliu* (Tag.); *bundieu* (Ig.); *bungliu* (Tag.); *goyung-góyung* (Tag.); *hagdan-anak* (C. Bis.); *malapapáya* (Tag., Bis., Pang.); *mano-máno* (Yak.); *bungloi* (Bis.); *tukod-lañgit* (Tag., Pamp.).

This tree occurs in Benguet, Pangasinan, Zambales, Rizal, Bataan, Laguna, Tayabas, and Sorsogon Provinces in Luzon; Palawan; Leyte; Mindanao; and Basilan, in second-growth forests, at low and medium altitudes. It also occurs in Java to the Moluccas.

Wehmer(68) records that the leaves contain a toxic principle, a saponin (polyscias-saponin).

According to Kalaw and Sacay(33) the plant is a popular fish poison in the Philippines. The leaves contain saponin.

MYRSINACEÆ

AEGICERAS CORNICULATUM (Linn.) Blanco.

Rhizophora corniculata Linn.
Aegiceras majus Gaertn.
Malaspinaea laurifolia Presl
Aegiceras malaspinaea A. DC.

Local names: *Batag-batag* (Sbl.); *bulali* (P. Bis.); *dumanai* (Ibn.); *kauilan* (C. Bis.); *kindug-kindug* (Tag.); *lamauas* (Bag.); *pilapil* (Tag.); *pipisik* (Tag.); *saging-ságing* (P. Bis., C. Bis., Tag.); *saging-sagiñgan* (Tag.); *sulásig* (Tag.); *tagisa* (Sul.); *tayókon* (C. Bis.); *timbambakis* (Tag.); *tindók* (Tag.); *tinduk-tindúk* (Sul.); *tundók* (Tag.); *tundok-tundók* (S. L. Bis.); *tunduk-tundúkan* (Tag.); *tiñgan-bagis* (Tag.).

This species is common along the seashore and tidal streams on most or all islands. It is also reported from India to southeastern China throughout Malaya to tropical Australia.

The bark is used as a fish poison. According to Burkill(10) the bark contains aegiceras-saponin.

MAESA CUMINGII Mez.

Maesa membranacea A. DC.

Local names: *Katiput* (Tag.); *malalapi* (Sbl.); *patipol* (Tag.); *patipot* (Sbl., Tag.); *silunau* (Tag.).

This is an endemic species, common in thickets and forests, at low and medium altitudes, occurring in Abra, Bontoc, Ben-

guet, Pangasinan, Zambales, Nueva Ecija, Bulacan, Rizal, Bataan, Laguna, Tayabas, and Camarines Provinces, in Luzon; Mindoro; Palawan; Romblon, and Mindanao.

Brown(8) reports that the bark of this species is useful for poisoning fish. Burkill(10) also reports this species as poisonous to fish in Malaya. The poisonous action is due to saponin.

MAESA DENTICULATA Mez.

Maesa membranacea Blanco

Local names: *Burobalatong* (P. Bis.); *dagangdang* (Sul.); *kalikot* (Tag.); *katikot* (Tag.); *logut* (Tag.); *magutata* (Sul.); *malabulik* (Neg.); *malatotis* (S. L. Bis.); *nukud* (Tagb.); *ototai* (Ig.); *palang* (Tag.); *patipat* (Tag.); *saan-kabáyo* (Pamp.); *solinau* (Tag.); *tablong* (Sbl.).

This endemic species occurs in most or all islands and provinces at low and medium altitudes, ascending to 1,200 meters, in thickets, secondary forests, and in openings in primary forests.

According to Brown(8) the whole plant is used to stupefy fish, which are afterwards collected from the surface of the water. Bacon(1) records the presence of one of the saponin glucosides.

MAESA LAXA Mez.

Maesa indica A. DC.
Bassovia sylvatica Blanco
Maesa grossedentata Mez

Local names: *Bagumaomau* (Bik.); *kalapailapai* (Bik.); *malataiutes* (S. L. Bis.); *tablong* (Tag.); *tablonglong* (Tag.); *tagbaya* (Mang.); *tubang-aso* (Tag.).

This is another endemic species, common in secondary and also often in primary forests, at low and medium altitudes, practically throughout the Philippines.

The fruit of this plant is used to poison fish, according to Brown.(8)

EBENACEÆ

DIOSPYROS EBENASTER Retz.

Sapote negro Sonn.
Diospyros sapota Roxb.
Diospyros nigra Perr.
Sapota nigra Blanco
Diospyros nigra Blanco

Local names: *Sapote* (Tag.); *zapóte negro, zapote* (Sp.).

Sapote is occasionally planted in and about towns as an ornamental foliage tree and for its large edible fruits, and also as a shade tree. It is nowhere spontaneous in Isabela, Nueva Ecija, Bataan, and Rizal Provinces in Luzon, and in other provinces. It was introduced from Mexico during the early colonial period.

It is known here as a fish poison plant. Burkill,(10) however, reports that in the West Indies the unripe fruits were said to be pounded and thrown in water. The fish narcotized by this method might be caught.

DIOSPYROS MARITIMA Blume.

Cargillia laxa R. Br.

? *Diospyros biflora* Blanco

Local names: *Kalúmai* (S. L. Bis.); *kanómai* (Pang., Tag., Bik.); *kanómas* (P. Bis.); *kanúmai* (Ilk., Tag., Bik., Kuy., P. Bis., Chab.); *malatinta* (Pamp.); *marumangkái* (Tag.); *tauag* (Tagb.).

This species occurs in most or all islands and provinces at low altitude, often common in thickets and forests along the seashore, occurring also inland. It is also reported from Java to New Guinea, Samoa, and tropical Australia.

The fruits are crushed and mixed with gravel and thrown into water to poison fish.

DIOSPYROS MULTIFLORA Blanco.

According to Villadolid and Sulit(64) the fruit of this tree is used as fish poison. It may be prepared according to them as follows: Fruits, preferably collected at the time they are just showing indication of ripening, are pounded in a wooden mortar and mixed with a small quantity of soil. Care must be taken in handling the fruits as the juice is corrosive and may burn the skin. Experience has shown that a petroleum can of powdered fruits is sufficient to kill fish in a pool or pond about twenty square meters in area and about two or three meters deep. The application of the poison may be about six o'clock. This poison has been found to be more effective in fresh water than in salt water.

Bacon(1) reports this plant as a violent fish poison. It is reported by the natives that the fruits are exceedingly poisonous, and that they will quickly kill fish, and will even cause a crocodile to leave the water. He also maintains that the juice of the fruits when applied to the human skin blisters it and causes it to turn black. Bacon conducted experiments on the

toxicity of the fruits. He finds that a peculiar acid is present in the fruits, which seems to belong to the tannic acid series, and to which he provisionally assigns the irritating properties of the plant. Brown(8) states that the bark is used also for poisoning fish.

APOCYNACEÆ

CERBÉRA MANGHAS Linn.

According to Guerrero(25) the seeds are toxic, and are used in fishing in small streams. Burkill(10) reports also that in Malaya the seeds are poisonous to fish. Gimlette(19) adds that the plant is also used as a fish poison in Celebes.

KIBATALIA BLANCOI (Rolfe) Merr.

Kickxia Blancoi Rolfe
Kickxia arborea F.-Vill.
Kickxia Merrittii Merr.
Kickxia Macgregori Elm.

Local names: *Ayéte* (Mang.); *kagpaáyan* (Ilk.); *lanéti* (P. Bis.); *laníting-gúbat* (Tag.); *pasnit* (Ilk.).

This endemic species occurs in Cagayan, Ilocos Sur, Batangas, and Laguna Provinces in Luzon; Catanduanes, Mindoro, Sibuyan, Guimaras, Negros, and Leyte, in secondary and primary forests at low and medium altitudes.

The bark and leaves of this plant are used for killing fish.(8)

THEVETIA PERUVIANA (Pers.) Merr.

Cerbera peruviana Pers.
Cerbera thevetia Linn.
Thevetia neriifolia Juss. ex. Steud.

Common name: *Yellow oleander* (Engl.).

Yellow oleander is cultivated as an ornamental plant in the larger towns of the Philippines. It was introduced from tropical America, and now pantropic in distribution.

Chopra(12) records that the oil from the kernel contains a glucoside, thevetin.

The bark and leaves of this plant are used for killing fish.(8) Heyne(29) says that in Java the wood is reported used as a fish poison.

VOACANGA GLOBOSA (Blanco) Merr.

Tabernaemontana globosa Blanco
Voacanga Cumingiana Rolfe
Orchipeda foetida F.-Vill.

Local names: *Alibútbut-ñga-bai* (P. Bis.); *bayág-kambíng* (Tag.); *bayág-usá* (Tag., Bik.); *galofag* (Gad.); *gañga* (Neg.); *itlóg-usá* (Tag., Bik.); *lapit-usá* (Bik.); *litá* (C. Bis.); *makabúñga* (Bik.); *pandakáking*

kalabáu (Tag.); *pantog-sa-usá* (Bis.); *parip-usá* (Bik.); *talanísog* (P. Bis.).

This common endemic species is found throughout the Philippines, in secondary and primary forests, at low altitudes.

The pounded fruits are used to stupefy eels.(8)

ASCLEPIADACEÆ

ASCLEPIAS CURASSAVICA Linn.

Asclepias syriaca Blanco

Local names: *Anibung* (Bong.); *balihig* (If.); *bubúyan* (Tag.); *bulak-bulákan* (Tag.); *bulak-damo* (Tag.); *bulak-kastila* (Tag.); *bukitkit* (Tag.); *kapos de francia* (Pang.); *koronítas* (Bik.); *daldal* (Iv.); *kala-láuan* (Tag.); *kapol-kapol* (Tag.); *ligurias* (P. Bis.); *pasanglai* (Bon.); *punga-nen* (Iv.); *sabsabrong* (Ilk.).

This weed, now pantropic in distribution, is of American origin. It occurs throughout the Philippines, in the settled areas, in open waste places in and about settlements, ascending to at least 1,500 meters.

Gram(21) has found the plant to contain an active principle of a glucosidal character, which he named asclepiadin.

While this plant is well known as medicinal in the Philippines, we have no information that it is being used for poisoning fish. According to Hamlyn-Harris and Smith(26) the adoption of this plant as a fish poison on the Don River in Queensland is comparatively recent.

VERBENACEÆ

CALLICARPA CANA Linn.

Callicarpa bicolor Schauer

Local names: *Alalui* (C. Bis.); *alayo-ti-manok* (Pang.); *anobrang* (Ilk.); *anuyup* (Ibn., Ilk.); *palis* (Tag.); *papalsis* (Tag.); *tambalási* (Tag.); *tambul-basi* (Sul.); *tígau* (Bis., Bik., Tag.); *tígau-na-itím* (Tag.); *túbang-daläg* (Tag.).

This species is found in most or all islands and provinces in the Philippines, growing in thickets and secondary forests, at low altitudes. It occurs also in Malay Peninsula and Archipelago to the Bismarck Archipelago, the Marianne, Caroline, and Palau Islands.

Villadolid and Sulit(64) give the following account of this plant as a fish poison: The leaves are used as fish poison. These are prepared as poison by pounding them with earth in a wooden mortar until they become powderlike in appearance. When the leaves become juicy, the mixture is ready for use. A ganta

of such mixture will be strong enough to stun and even kill the fish in a pool of about one meter deep and five meters wide. The poison may be applied any time of the day, but five o'clock or six o'clock in the morning is the usual time of application. The poison takes effect within an hour after application. Brown(8) also reports that the leaves of this plant are pounded and then used as fish poison.

CALLICARPA ERIOCHLONA Schauer.

Local names: *Kagong* (Bag.); *palis* (Tag.); *salingárau* (Neg.); *tambalabási* (Tag.); *tígau* (Tag., P. Bis.); *túbang-daláq* (Tag.).

The plant has been reported from Cagayan to Sorsogon in Luzon; Mindoro, Leyte, Negros, and Mindanao, as occurring in primary and secondary forests at low altitudes, often rather common. It also occurs in Borneo, Celebes, New Guinea, New Britain, and New Ireland.

According to Villadolid and Sulit(64) the plant is used as a fish poison. The method of preparing the poison and its application is similar to that of *Callicarpa cana.* Brown(8) also mentions the leaves of this plant as useful for poisoning fish.

CALLICARPA FORMOSANA Rolfe.

Callicarpa americana Blanco
Callicarpa attenuata Walp.
Callicarpa Blancoi Rolfe
Callicarpa ovata C. B. Rob.

Local names: *Anadhiu* (Ig.); *anoyop* (Ilk., Ibn.); *anoyot* (Ilk.); *atólba* (If.); *palis* (Tag.); *tambalabási* (Tag.); *tiagau* (Tag.); *tigau* (Tag., Bis., Bik.); *tigau-tigau* (C. Bis.); *tigbabási* (Bik.); *timbabási* (Tag.); *túbang-daláq* (Tag.); *tubaybási* (Tag.).

This is a common species occurring throughout the Philippines, in thickets and secondary forests, at low and medium altitudes. It also occurs in Formosa.

According to Villadolid and Sulit(64) the leaves of this plant are used as a fish poison. The methods used in preparing the poison and its application is similar to those of *Callicarpa cana.* Kalaw and Sacay(33) also report the use of this plant in poisoning fish. Saponin is present in the leaves, bark, and roots. Brown(8) and Guerrero(25) state that the leaves are pounded and used as fish poison.

VITEX PARVIFLORA Juss.

Vitex timoriensis Walp.
Vitex littoralis Decne.

Vitex altissima Blanco
Vitex geniculata Blanco
Vitex latifolia Blanco
Vitex cofassus Reinw. var. *pubescens* Hallier f.
Vitex cofassus Reinw. var. *pubescens* Hallier f.
Vitex glandulosa H. Lam

Local names: *Adgaúon* (S. L. Bis.); *alah* (Bag.); *amaráun* (Bik., Bis.); *amaúan* (Gad.); *amugaúan* (Ibn.); *amulaúon* (Mbo.); *anla* (Bag.); *bulaúen* (Pang.); *burikán* (Bag.); *edieu* (Bon.); *hamolaúen* (P. Bis.); *hamoráon* (Bik., S. L. Bis.); *hamulai* (Sul.); *hamulaúon* (Sul.); *hamuráon* (Bik.); *hamúyan* (C. Bis.); *huláh* (Bag.); *kalipápa* (Sub., Sul.); *kalipápabató* (Sub., Mag.); *kulipápa* (Mag.); *kulimpápa* (Mag.); *malabalinanau* (Sbl.); *maraúin* (Bis., P. Bis.); *maulaúin-aso* (Kuy.); *molaúin* (P. Bis., Chab., Tag.); *moláve* (Ilk., Sbl., Tag., Pamp., Bik., S. L. Bis., P. Bis., C. Bis., Lan.); *moláve-batú* (C. Bis., Sul.); *moláve de playa* (Sp.); *mulaúin* (Pang., Tag., Sbl., Bik., Sul.); *muláon* (P. Bis.); *sagad* (Ilk.); *salingkápa* (Bis.); *muraúin* (Bis.); *sagat* (Ilk., Ting.); *sasalit* (Mag.); *topas* (Bag.); *tugas* (P. Bis., C. Bis.); *tugas-abgauon* (S. L. Bis.); *tugas-lanhan* (Bis.); taga (Ibn.).

This valuable timber tree, commercially known as molave, is common in all or most islands and provinces throughout the Philippines, in both secondary and primary forests, at low altitudes. It also occurs in Saleyer, Timor, Java, Celebes, and Amboina.

The fruits are ground, and with the bark are used as a fish poison. Both hydrocyanic acid and saponin are present in the leaves, bark, and fruits.(33)

RUBIACEÆ

GARDENIA CURRANII Merr.

Randia aculeata Blanco

Local names: *Malarayap* (Tag.); *malasampága* (Tag.); *sinasampága* (Tag.).

This endemic species is reported only from Rizal, Pangasinan, Bataan, and Batangas Provinces in Luzon.

According to Villadolid and Sulit(64) the fruits are used as a fish poison. They describe the method of preparing the poison as follows: The ripe fruits are powdered with earth in a wooden mortar. About a petroleum can of the powdered fruit is effective in a pool about a meter deep and ten meters wide. The poison has been found to be more effective in fresh water than in salt water. The time of application, according to experienced users, is about five to six o'clock in the morning. The poison is said to take effect within an hour after application.

CUCURBITACEÆ

LUFFA CYLINDRICA (Linn.) Roem.

Momordica luffa Linn.
Momordica cylindrica Linn.
Luffa petola Seringe
Luffa aegyptiaca Mill.

Local names: *Kabatíti* (Bon., Ilk.); *kabatítit-aso* (Ilk.); *patóla* (Bis., Big., Tag.); *patólang bilog* (Tag.); *potúlang-uák* (Tag.); *patúla-amu* (Sul.); *salag-salag* (Tag.); *tabau-tábau* |Ilk.); *tabóbok* (Tag.); *tabúbok* (Tag.).

Patólang bilog is commonly cultivated in the Philippines for its edible fruits. The wild forms have smaller fruits, and occur in thickets in the settled areas. It is pantropic in cultivation.

Peckolt(46) isolated from the fruits a bitter principle, a saponin.

The fruits of the wild form are not edible, as their juice is very bitter. We have no report that the fruits of the wild form had been used for poisoning fish. But Roth(54) and Palmer(44) report that in Mitchell, Gilbert, and Einasleigh Rivers, in Queensland, *Luffa aegyptiaca,* which is a synonym of the above species, is used to poison fish when green.

COMPOSITÆ

BLUMEA BALSAMIFERA (Linn.) DC.

Conyza balsamifera Linn.

Local names: *Alibun* (P. Bis.); *alimon* (P. Bis.); *ayoban* (Bis.); *bukadkad* (S. L. Bis.); *dalapot* (C. Bis.); *gabuen* (Bis.); *gintin-gintin* (Bis.); *gitin-gitin* (Bis.); *hamlibon* (Bis.); *kaliban* (Tagb.); *kalibura* (Tagb.); *labúlan* (Sub.); *lakadbúlan* (Big., Sul.); *lakákdan* (Bis.); *lakdanbúlan* (Bis.); *sambún* (Sul.); *sambóng* (Tag., Pamp.); *sobsob* (Ilk.); *sobosob* (Ig.); *subusub* (Ilk.); *takamáin* (Bag.).

This species is common in open grasslands at low and medium altitudes in all or most islands and provinces in the Philippines. It is also reported from India to southern China through Malaya to the Moluccas.

The leaves of this plant are used with other plants for poisoning fish. Their efficacy is questionable according to Brown.(8)

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A REVIEW OF PHILIPPINE STROMBIDÆ [1]

By GODOFREDO L. ALCASID

Of the Natural History Museum Division
Department of Agriculture and Commerce, Manila

This paper presents a revision of the Family Strombidæ known or reported to occur in the Philippines. It is a continuation of the study of Philippine recent Mollusca. The procedure of the study and the arrangement of this paper are similar to those followed in a previous publication.[2] The material upon which this paper is based is largely in the collection of the Natural History Museum Division, Department of Agriculture and Commerce, Manila.

Family STROMBIDÆ D'Orbigny

Shell usually solid, imperforate, lip more or less dilated, sometimes digitated; aperture canaliculated, columella callous, devoid of plaits; opercle siliceous, generally unguiculate.

Eyes pedunculate or sessile; tentacles slender; proboscis contractile, annulate; siphon short, dentition tænioglossate. Foot slender and strong, enabling the animal to move in short jumps instead of by the smooth gliding motion common to most gastropods.

Key to the genera of Philippine Strombidæ.

*a*¹. Outer lip expanded, tubularly digitated .... *Pterocera.*
*a*². Outer lip more or less expanded, entire, sometimes slightly digitated.
  *b*¹. Lip usually dilated, margin entire; shell heavy, ovate, turreted. *Strombus.*
  *b*². Shell fusiform, cancellated; anterior canal short, posterior canal rather long, closely applied to spire .... *Rostellaria.*
  *b*³. Shell elongate, subcylindrical, thin, lip simple .... *Seraphs.*

[1] This paper with 5 plates was originally submitted in 1941, but the war prevented its publication. The plates, unfortunately, were lost during the emergency.

[2] Alcasid, Godofredo L. Philippine Recent Shells. Phil. Jour. Sci. 61 (1936) 489–499, pls. 1, 2.

Genus PTEROCERA Lamarck

SAANG-LAKI (Cebu)

SCORPION SHELLS

Pterocera LAMARCK, Anim. sans Vert. 7 (1882) 194.

Shell ovate, spire turriculate; aperture narrow, elongate; lip broadly dilated, tubularly digitated; operculum narrowly unguiculate, margins serrate.

Key to the Philippine species of Pterocera.

a^1. Columella smooth; lip 7-clawed.
  b^1. Body whorl slightly tubercled; claws short, upturned; interior of aperture pale flesh-colored .... *P. bryonia.*
  b^2. Body whorl slightly tubercled; claws slender, interior deep orange. *P. aurantia.*
  b^3. Body whorl very strongly tubercled; claws slender, three on lip upturned; interior flesh-colored .... *P. lambis.*
a^2. Columella wrinkled.
  b^1. Lip 6-clawed.
    c^1. Columella very slightly wrinkled; interior deep flesh-colored. *P. chiragra.*
    c^2. Columella strongly wrinkled; interior dark purple .... *P. rugosa.*
  b^2. Lip 7-clawed, claws tubercled; interior pinkish flesh, stained with deep violet .... *P. scorpio.*
  b^3. Lip 9-clawed; aperture deep purple, wrinkles white........ *P. elongata.*
  b^4. Lip 10-clawed; aperture smoky purple, wrinkles whitish. *P. millepeda.*

PTEROCERA BRYONIA (Gmelin).

Strombus bryonia GMELIN, p. 3520.
Strombus truncatus DILLWYN, Cat. Rec. Shells 2 (1817) 659.
Pterocera truncata LAMARCK, Anim. sans Vert. 7 (1822) 195; SOWERBY, Thes. Conchyl. 1^2 (1842) 41, pl. 11, fig. 13; KIENER, Icon. Coq. Viv. Pterocera 4 (1843) 3, pl. 10, fig. 3.
Pterocera bryonia GMELIN in Reeve, Conchol. Icon. Pterocera 6 (1851) pl. 1; TRYON, Man. Conchol. 7 (1885) 124, pl. 8, fig. 4; pl. 9, fig. 8; HIDALGO, Cat. Marine Moll. (1904) 138; FAUSTINO, Bur. Sci. Monog. 25 (1928) 210.

Shell oblong-ovate; spire often truncate; whorls transversely striated, upper part concave, angle strongly noduled, body slightly tubercled; lip very widely expanded, 7-clawed, claws stout, rather curved posteriorly; creamy white, a little stained with brown; interior smooth, pale flesh-colored; columella callous.

Length, 220 millimeters; breadth, 140; thickness, 97; height of spire, 68; height of body whorl, 168.

SIBUYAN, Romblon Province, *Bur. Sci. 14690 Lopez;* CEBU and MINDANAO, *Hidalgo.* LUBANG, Mindoro Province, *Bur. Sci. 14887 de Mesa.*

A very large species, measuring a little less than a foot in its entire length, characterized by the tubercles on the body whorl, with the digits short and stout. The columella is covered by a callosity which extends to the dorsal surface, almost entirely covering the spire. The external coloration is lighter than that of *P. lambis*, and the digits shorter.

PTEROCERA AURANTIA Lamarck.

Pterocera aurantia LAMARCK, Anim. sans Vert. 7 (1822) 198; SOWERBY, Thes. Conchyl. 1[2] (1842) 42, pl. 11, fig. 11; KIENER, Icon. Coq. Viv. Pterocera 4 (1843) 11, pl. 7; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 5, fig. 7; TRYON, Man. Conchol. 7 (1885) 124, pl. 9, fig. 5; HIDALGO, Cat. Marine Moll. (1904) 138; FAUSTINO, Bur. Sci. Monog. 25 (1928) 210.

Shell ovate; spire acuminate; whorls transversely finely striated, upper part rather concave, angle noduled, body whorl lightly tubercled; lip expanded, 7-clawed, claws curved, generally pointing posteriorly, three side claws short, the rest rather long; yellowish white, stained with pale-orange blotches throughout; interior of aperture very deep orange, smooth; columella callous.

Length, 60 millimeters; breadth, 38; thickness, 27; height of spire, 16; height of body whorl, 46.

MINDANAO, Surigao Province, *Bur. Sci. 209, Quadras.* On the reefs.

A medium-sized shell, easily recognized by the deep orange of the aperture and the slender curved claws.

PTEROCERA LAMBIS (Linnæus).

Strombus lambis LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1208; DILLWYN, Cat. Recent Shells 2 (1817) 658.

Pterocera lambis LAMARCK, Anim. sans Vert. (1801) 81; 7 (1822) 196; KIENER, Icon. Coq. Viv. Pterocera 4 (1843) 7, pl. 3; pl. 4, fig. 1.

Pterocera lambis (Linnæus) SOWERBY, in Thes. Conchyl. 1[2] (1842) 41, pl. 11, figs. 5, 6, 7; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 5, fig. 8; TRYON, Man. Conchol. 7 (1885) 124, pl. 8, figs. 1–3; HIDALGO, Cat. Marine Moll. (1904) 138; FAUSTINO, Bur. Sci. Monog. 25 (1928) 210.

Shell oblong-ovate; spire acuminate; whorls transversely striated, upper part concave, angle strongly noduled; body whorl very prominently tubercled; lip rather expanded, digitated; digits seven, slender, long, a few on the lip upturned; yellowish brown, spotted with reddish brown throughout; interior of aperture pale flesh-colored; columella callous, smooth.

Length, 120 millimeters; breadth, 67; thickness, 75; height of spire, 28; height of body whorl, 68.

LUZON, *Bur. Sci. 16052 Mitchell.* BATAN, Albay Province, *Bur. Sci. 12853, 12854, 12856, 12957 Faustino and Abad.* MINDORO, Puerto Galera, *Bur. Sci. 14698 Seale, 14699 Alcasid.* CEBU, Cebu, *Bur. Sci. 11820 Smith.* MACTAN, Cebu Province, *Bur. Sci. 13734 Smith.* BOHOL, *Bur. Sci. 14168 Kelley.* SIBUYAN, Romblon Province, *Bur. Sci. 14700 Lopez.* NEGROS, Sicaba, *Bur. Sci. 14701 Talavera;* Escalante, *Bur. Sci. 14702 Talavera.* LEYTE, San Isidro, Daha, *Bur. Sci. 14703 Teves.* BUSUANGA, Palawan Province, *Bur. Sci. 12742 Lopez.* CUYO, Palawan Province, *Bur. Sci. 12097, 12098 Lopez.* DINAGAT, Surigao Province, *Bur. Sci. 12248 Lopez.* JOLO, *Bur. Sci. 14704 Smith.*

This species is most abundant in the Philippines. It can be easily distinguished from the preceding species by the very prominent tubercles on the last whorl, the less expanded lip, the longer and slender digits, and the livid flesh color of the interior of the aperture. The spire is always acuminate and the shoulders of the whorls are strongly noduled.

PTEROCERA CHIRAGRA (Linnæus).

Strombus chiragra LINNÆUS, Syst. Nat. ed. 12 1² (1767) 1207; DILLWYN, Cat. Recent Shells 2 (1817) 657.

Pterocera chiragra LAMARCK, Anim. sans Vert. 7 (1822) 198; KIENER, Icon. Coq. Viv. Pterocera 4 (1848) 5, pl. 5; pl. 10, fig. 2.

Pterocera chiragra (Linnæus) SOWERBY, Thes. Conchyl. 1² (1842) 42, pl. 11, fig. 12; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 2; TRYON, Man. Conchol. 7 (1885) 126, pl. 10, fig. 13; HIDALGO, Cat. Marine Moll. (1904) 138; FAUSTINO, Bur. Sci. Monog. 25 (1928) 210.

Shell oblong-ovate; spire rather short, acuminate; whorls concave, angles noduled, transversely striated, striæ raised, more or less regular; body whorl rudely transversely ribbed, ribs tubercled; lip rather expanded, 6-clawed, claws curved, generally pointed posteriorly, rather long, stout; whitish, variegated with reddish-chestnut throughout; columella and interior of aperture deep flesh-colored, very slightly wrinkled.

Length, 113 millimeters; breadth, 90; thickness, 69; height of spire, 23; height of body whorl, 90.

BATAN, Batanes Province, Basco, *Bur. Sci. 14666 Lopez.* MINDORO, Puerto Galera, *Bur. Sci. 204, 13732 Seale, 14582 Teves.*

CEBU, Cebu, *Bur. Sci. 14705 Smith.* SEMIRARA, Antique Province, *Phil. Nat. Hist. Mus.*[3] *15501 Alcasid.*

A large species, widely distributed throughout the Philippines. It is easily distinguished by its variegated dorsal surface, its widely expanded claws, and the very slightly wrinkled flesh-colored interior. The digits of this species are rather channelled and open near the base.

PTEROCERA RUGOSA Sowerby.

Pterocera rugosa SOWERBY, Thes. Conchyl. 1 [2] (1842) 42, pl. 11, figs. 9, 10; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 4, fig. 6; TRYON, Man. Conchol. 7 (1885) 126, pl. 10, fig. 12; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Shell oblong-ovate; spire short, acuminate; whorls concave, angles obsoletely noduled, transversely finely striated; body whorl rudely transversely ribbed; ribs tubercled; lip rather expanded, 6-clawed; claws rather long, curved, generally pointing posteriorly; whitish, variegated with reddish chestnut throughout; columella and interior of aperture strongly wrinkled throughout, very dark purple gradually diminishing to a deep flesh at the border of the lip; wrinkles yellowish white.

Length, 78 millimeters; breadth, 59; thickness, 40; height of spire, 19; height of body whorl, 59.

The specimen here described, *Bur. Sci. 13080*, was purchased from H. C. Fulton and was obtained by him from Ceylon. The first record crediting this species to the Philippines appears to be Hidalgo's Catalogue, based on a collection of Baranda now in the Museo de Madrid.

PTEROCERA SCORPIO (Linnæus).

Strombus scorpius LINNÆUS, Syst. Nat. ed 12 1 [2] (1767) 1208; DILLWYN, Cat. Recent Shells 2 (1817) 657.

Pterocera scorpio LAMARCK, Anim. sans Vert. 7 (1822) 197; SOWERBY, Thes. Conchyl. 12 (1842) 43, pl. 11, fig. 1; KIENER, Icon. Coq. Viv. Pterocera 4 (1843) 13, pl. 6; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 3, fig. 3; TRYON, Man. Conchol. 7 (1885) 125, pl. 9, fig. 6; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Shell oblong-ovate, spire rather short, acuminate; whorls flatly inclined at upper part, angle sharp, very slightly tubercled,

[3] Specimens acquired after the organization of the Philippine Natural History Museum.

transversely finely striated; body whorl transversely rudely ribbed; ribs tubercled; lip rather expanded, 7-clawed; claws noduled; three side claws short, curved; anterior claw long, slender, very slightly noduled; three posterior claws long, strongly noduled; yellowish white, variegated throughout with chestnut; columella and interior strongly wrinkled, dark purple, gradually diminishing to pinkish flesh towards the border of the lip; wrinkles yellowish white.

Length, 58 millimeters; breadth, 37; thickness, 25; height of spire, 13; height of body whorl, 45.

MINDORO, Naujan, *Bur. Sci. 208 Quadras.* MARINDUQUE, BOHOL, and CEBU, *Elera.* MINDANAO, Zamboanga Province, *Hidalgo.*

Easily distinguished by its nodulous claws and dark-purple, strongly wrinkled interior.

PTEROCERA MILLEPEDA (Linnæus).

Strombus millepeda LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1208; DILLWYN, Cat. Recent Shells 2 (1817) 659.

Pterocera millepeda LINNÆUS in Lamarck, Anim. sans Vert. 7 (1822) 196; SOWERBY, Thes. Conchyl. 1[2] (1842) 43, pl. 11, fig. 3; KIENER, Icon. Coq. Viv. Pterocera 4 (1843) 10, pl. 9, fig. 1; pl. 10, fig. 1; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 6, fig. 10; TRYON, Man. Conchol. 7 (1885) 125, pl. 9, fig. 9; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Shell oblong-ovate, spire rather short, acuminated; whorls concave, angle strongly noduled, transversely finely striated; body whorl transversely ribbed; ribs rudely tubercled; lip rather expanded, 10-clawed; claws short, those at the side curved, pointing posteriorly; anterior claws long, slightly bent; whitish, stained with orange blotches; interior of aperture and columella smoky-purple, gradually diminishing to a very light chestnut at border of lip; strongly wrinkled; wrinkles yellowish white.

Length, 84 millimeters; breadth, 52; thickness, 35; height of spire, 24; height of body whorl, 60.

BANTAYAN, Cebu Province, *Bur. Sci. 14706 Lopez.* SIBUYAN, Romblon Province, *Bur. Sci. 14707 Lopez.* SAMAR, *Bur. Sci. 11782.* MINDANAO, *Bur. Sci. 207 Quadras.*

PTEROCERA ELONGATA Swainson.

Strombus millepeda LINNÆUS (in part) in Dillwyn, Cat. Recent Shells 2 (1817) 660.

Pterocera elongata SWAINSON in Sowerby, Thes. Conchyl. 1[2] (1842) 44, pl. 11, fig. 4; KIENER, Icon. Coq. Viv. Pterocera 4 (1843) 8, pl. 8; REEVE, Conchol. Icon. Pterocera 6 (1851) pl. 6, fig. 9; TRYON, Man. Conchol. 7 (1885) 125, pl. 9, fig. 10; HIDALGO, Cat. Marine Moll. (1904) 138; FAUSTINO, Bur. Sci. Monog. 25 (1928) 210.

This species is very closely allied to the preceding, differing only in its slenderer form, in having less digits, and in the deeper body coloration. It is regrettable that there is no specimen in the Museum's collection, so that the writer had no opportunity of examining one.

Genus STROMBUS Linnæus

Strombus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1207.

Shell ovate; spire turreted; body whorl prominent; aperture elongate, truncate and channelled anteriorly, canaliculate posteriorly; lip somewhat broadly expanded, plain, lobed, or slightly digitated. Operculum unguiculate.

Key to Philippine species of Strombus.

a^1. Lip broadly expanded.
  b^1. Border of lip thickened and in-folded.
    c^1 Upper part solid; aperture white .... *S. latissimus.*
    c^2. Upper part thin, digitated; aperture deep purple........ *S. laciniatus.*
  b^2. Lip thickened; simple or lobed.
    c^1. Lip lobed at the upper part .... *S. auris-dianæ.*
    c^2. Lip simple.
      d^1. Body strongly noduled.
        e^1. Aperture flesh-colored .... *S. lentiginosus.*
        e^2. Aperture dark safron to purple .... *S. papilio.*
      d^2 Body smooth or slightly noduled.
        e^1. Aperture with short posterior canal.
          f^1. Lip very thick; body covered with longitudinal, wavy, brown streaks .... *S. canarium.*
          f^2. Lip rather thin, body plain orange-brown........ *S. isabella.*
        e^2. Aperture with long decumbent posterior canal.
          f^1. Interior of aperture smooth.
            g^1. Body creamy white .... *S. epidromis.*
            g^2. Body mottled and transversely banded with brown; columella blotched with dark chestnut........ *S. variabilis.*
            g^3. Body reddish brown, interior bright lemon-yellow. *S. minimus.*
          f^2. Interior of aperture lightly radiately striated.
            g^1. Interior of aperture wavy white .... *S. labiosus.*
            g^2. Interior of aperture stained with rusty brown. *S. columba.*

a^2. Lip slightly expanded.
  b^1. Spire very much exserted .... *S. vittatus.*
  b^2. Spire not very much exserted.
    c^1. Body whorl not tubercled.
      d^1. Aperture with long, decumbent, posterior canal.
        e^1. Spire acutely angled .... *S. marginatus.*
        e^2. Spire finely tubercled .... *S. succinctus.*

d^2. Aperture with very short posterior canal.
e^1 Aperture white .... *S. gibberulus.*
e^2. Aperture deep flesh-colored .... *S. lubuanus.*
c^2. Body whorl tubercled.
d^1. Columella completely striated.
e^1. Body tubercles prominent .... *S. dentatus.*
e^2. Body tubercles not prominent .... *S. floridus.*
d^2. Columella partly striated.
e^1. Shell transversely striated at base only .... *S. urceus.*
e^2. Shell transversely striated throughout.
f^1. Shell elongate .... *S. elegans.*
$f.^2$. Shell short and stout .... *S. rugosus.*
a^3. Lip not expanded. Shell slender, lip slightly lobed or simple.
b^1. Lip 3-lobed .... *S. samar.*
b^2. Lip simple.
c^1. Shell subcylindrical, stout; aperture dark chestnut .... *S. bulbulus.*
c^2. Shell elongate, thin, smooth; mottled with brown; aperture white. *S. terebellatus.*

STROMBUS LATISSIMUS Linnæus.

Strombus latissimus LINNÆUS, Syst. Nat. ed 12 (1767) 1211; DILLWYN, Cat. Recent Shell 2 (1817) 668; LAMARCK, Anim. sans Vert. 7 (1822) 250; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 4, fig. 4; TRYON, Man. Conchol. 7 (1885) 111, pl. 3, fig. 27; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 6, pl. 4; HIDALGO, Cat. Marine Moll. (1904) 136; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Shell ovate, swollen, rudely tubercled; spire conical, pointed; whorls 9 or 10, upper part concave, shoulders strongly noduled, oftentimes radiately ridged towards lip; lip broadly expanded, extending much beyond spire, side very much thickened and infolded; body whitish to yellowish, longitudinally lineated with orange-brown streaks and mottled with white blotches; interior of aperture white.

Height, 190 millimeters; breadth, 133; thickness, 18; height of spire, 45; height of body whorl, 145.

The only properly recorded specimen in the Museum's collection was purchased from H. C. Fulton, and is marked 'Philippines.' There are several specimens from the Quadras and Zobel collections, but they do not bear localities. However, this species has been reported by Cuming from Matnog, Sorsogon.

STROMBUS LACINIATUS Chemnitz.

Strombus laciniatus CHEMNITZ, Conch. Cab. 10 (1769–1829) 223, pl. 158, figs. 1506, 1507; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 11, fig. 25; TRYON, Man. Conchol. 7 (1885) 111, pl. 3, fig. 26; HIDALGO, Cat. Marine Moll. (1904) 136; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Strombus cristatus LAMARCK, Anim. sans Vert. 7 (1822) 202; KIENER, Icon Coq. Viv. Strombus 4 (1843) 8, pl. 11.

Shell ovate; spire exserted, turreted, spirally finely striated; whorls profusely noduled at angles, those on body whorl very strong; lip broadly expanded, extending and closely applied to spire, side thickly in-folded, upper part thin and rather digitated; columella callous; callosity covering greater part of spire; back of lip radiately ribbed; body whitish, variegated with orange-brown; interior of aperture deep-purple, fading towards lip.

Height, 108 millimeters; breadth, 75; thickness, 46; height of spire, 39; height of body whorl, 70.

MINDANAO, Surigao Province, *Bur. Sci. 222 Quadras.* DINAGAT, Surigao Province, *Bur. Sci. 12261 Lopez.*

The deep purple of the interior and the crested expanded lip characterize this species.

STROMBUS AURIS-DIANÆ Linnæus.

Strombus auris-dianæ LINNÆUS, Syst. Nat. ed 12 1[1] (1767) 1209; DILLWYN, Cat. Recent Shells 2 (1817) 663; LAMARCK, Anim. sans Vert. 7 (1822) 204; SOWERBY, Thes. Conchyl. 1[2] (1842) 35, pl. 9, figs. 101, 102; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 22, pl. 16, fig. 1; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 15, figs. 36*a*, *b*, 37; TRYON, Man. Conchol. 7 (1885) 113, pl. 4, figs. 37, 38; HIDALGO, Cat. Marine Moll. (1904) 134; IWAKAWA, Cat. Jap. Moll. (1919) 85; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Strombus lamarckii GRAY in Sowerby, Thes. Conchyl. 1[2] (1842) 35, pl. 9, figs. 88, 93, 98, 99; HIDALGO, Cat. Marine Moll. (1904) 136.

Strombus melanostomus SWAINSON in Kiener, Icon. Coq. Viv. Strombus 4 (1843) 19, pl. 12, fig. 1; pl. 14, fig. 2; SOWERBY, Thes. Conchyl. 1[2] (1842) 36, pl. 9, figs. 89, 90, 94; HIDALGO, Cat. Marine Moll. (1904) 136.

Strombus auris-dianæ var. *melanostomus* SWAINSON in Tryon, Man. Conchol. 7 (1885) 113, pl. 4, fig. 38.

Strombus guttatus (Martini) KIENER, Icon. Coq. Viv. Strombus 4 (1843) 24, pl. 15, fig. 1; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 14, fig. 33; HIDALGO, Cat. Marine Moll. (1904) 135; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Pugil guttatus lævis MARTINI, Conch. Cab. 8 (1769–1829) 126, pl. 84, fig. 840.

Shell oblong-ovate; spire acuminate; whorls eight, upper part concave, oftentimes transversely ridged, shoulders tubercled; outer lip expanded, thickened, upper part extended to a fingerlike lobe; columella callous, callosity extending to apex of spire; anterior canal upturned; body brownish, spotted with white; interior of aperture whitish, slightly wrinkled at upper part, throat orange.

Height, 67 millimeters; breadth, 35; thickness, 26; height of spire, 25; height of body whorl, 42.

LUZON, Bataan Province, Mariveles, *Hidalgo:* Tayabas Province, Catanauan, *Bur. Sci. 14035 Navarro.* SIBUYAN, Romblon Province, San Fernando, *Bur. Sci. 12065 Hayne.* MINDORO, Puerto Galera, *Bur. Sci. 14539 Alcasid;* Naujan, *Bur. Sci. 213 Quadras.* LUBANG, Mindoro Province, Looc Bay, *Bur. Sci. 14878 de Mesa.* MARINDUQUE, Gasan, *Bur. Sci. 215 Quadras.* CEBU, *Bur. Sci. 230 Quadras.* BURIAS, *Elera.*

There has been considerable conflict regarding the differences among typical *auris-dianæ* and the forms *melanostomus* and *guttatus.* All these forms are found in the Philippines and are considered as one in this report.

STROMBUS LENTIGINOSUS Linnæus.

Strombus lentiginosus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1208; DILLWYN, Cat. Recent Shells 2 (1817) 660; LAMARCK, Anim. sans Vert. 7 (1822) 203; SOWERBY, Thes. Conchyl. 1[1] (1842) 37, pl. 8, fig. 79; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 25, pl. 18, fig. 1; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 13, fig. 31; TRYON, Man. Conchol. 7 (1885) 110, pl. 3, figs. 23, 24; HIDALGO, Cat. Marine Moll. (1904) 136; IWAKAWA, Cat. Jap. Moll. (1919) 85; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Shell oblong-ovate; spire conical, short; whorls eight, profusely noduled at angles, those on body whorl strong, spirally striated along the upper part; columella callous, callosity sometimes extending to tip of spire; lip expanded, slightly thickened at side, somewhat lobed on upper part; body yellowish, spirally mottled with irregular chestnut-brown spots, interior of aperture flesh-colored, edge of lip tessellated with rectangular brownish blotches.

Height, 67 millimeters; breadth, 46; thickness, 33; height of spire, 20; height of body whorl, 48.

LUZON, *Bur. Sci. 16014 Mitchell;* Bataan Province, Orion Santo Domingo, *Bur. Sci. 15257 Carpenter.* MINDORO, Calapan, *Bur. Sci. 14884 de Mesa;* Naujan, *Bur. Sci. 219 Quadras;* Puerto Galera, *Bur. Sci. 14551 Alcasid.* MARINDUQUE, Boac, Laylay, *Bur. Sci. 218 Quadras.* BOHOL, *Bur. Sci. 14172 Kelley.* SOUTH GIGANTES, Iloilo Province, *Bur. Sci. 14669 Montalban.* DINAGAT, Surigao Province, *Bur. Sci. 12187 Lopez.* MINDANAO, Zamboanga Province, Dapitan, *Bur. Sci. 225, 226, 227, Quadras.*

The rugged sculpture on the dorsal side contrasted with a smooth ventral and variously mottled with chestnut-brown is more or less a constant characteristic of this species.

STROMBUS PAPILIO Chemnitz.

Strombus papilio CHEMNITZ, Conch. Cab. 10 (1769–1829) 226, pl. 158, figs. 1510, 1511; DILLWYN, Cat. Recent Shells 2 (1817) 661; LAMARCK, Anim. sans Vert. 7 (1822) 211; SOWERBY, Thes. Conchyl. 1[1] (1842) 31, pl. 7, fig. 44; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 26, pl. 17, figs. 1, 2; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 13, fig. 29; TRYON, Man. Conchol. 7 (1885) 110, pl. 3, fig. 25; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Shell ovate; spire conical, short; whorls profusely noduled at angles, those on body whorls strong, spirally striated throughout; columella callous, callosity extending to middle of spire; lip broadly expanded, thickened, situated at both ends; body whitish, spirally mottled with reddish-brown spots; interior of aperture dark safron to purple, radiately striated towards the margin.

Height, 47 millimeters; breadth, 32; thickness, 26; height of spire, 16; height of body whorl, 31.

BALABAC, *Bur. Sci. 691 Quadras.*

In sculpture the present species is similar to *S. lentiginosus*, from which it differs, however, by its smaller size and in the dark-purple and radiate striation within the interior of the expanded lip.

STROMBUS CANARIUM Linnæus.

Strombus canarium LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1211; DILLWYN, Cat. Recent Shells 2 (1817) 670; LAMARCK, Anim. sans Vert. 7 (1822) 202; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 33, pl. 29, figs. 1, 1*a;* SOWERBY, Thes. Conchyl. 1[1] (1842) 33, pl. 8, figs. 69, 70; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 18, figs. 46*a*, *b;* TRYON, Man. Conchol. 7 (1885) 110, pl. 2, figs. 18–20; pl. 3, fig. 21; HIDALGO, Cat. Marine Moll. (1904) 134; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Shell shortly ovate, heavy; spire short, rather acuminate, varicose; whorls smooth, gibbous, sulcated near the apex; columella callous, outer lip thick, widely expanded; fulvous with longitudinal, irregular, wavy, brown streaks; interior of aperture ivory; columella and edge of outer lip rusty fawn-brown.

Height, 57 millimeters; breadth, 40; thickness, 28; height of spire, 14; height of body whorl, 43.

LUZON, Bataan Province, Mariveles, *Bur. Sci. 229 Quadras.* LUBANG, Mindoro Province, Tagbac Bay, *Bur. Sci. 14885 de Mesa.* PALAWAN, Caramay, *Bur. Sci. 14933 Alcasid.* BUSUANGA, Coron, *Bur. Sci. 12121 Lopez.* LINAPACAN, Palawan Province, *Bur. Sci. 11897 Lopez.* MINDORO, Calapan, *Bur. Sci. 1446 de Mesa.* BATAN, Albay Province, *Bur. Sci. 12869 Faus-*

tino. SAMAR, *Jagor.* LEYTE, *Hidalgo.* CEBU, *Elera.* MINDANAO, Surigao and Zamboanga, *Hidalgo.*

This species is closely allied to *S. isabella*, with the shell generally heavier and possessed of longitudinal brown streaks.

STROMBUS ISABELLA Lamarck.

Strombus isabella LAMARCK, Anim. sans Vert. 7 (1822) 207; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 18, fig. 51; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 32, pl. 25, fig. 2; TRYON, Man. Conchol. 7 (1885) 110, pl. 2, fig. 20, pl. 3, fig. 21; HIDALGO, Cat. Marine Moll. (1904) 136; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Shell very similar in form to the preceding in which it is generally included. It may be distinguished, however, by its lighter shell, yellowish or orange-brown and not provided with the longitudinal streaks characteristic of *S. canarium.*

Height, 75 millimeters; breadth, 45; thickness, 34; height of spire, 24; height of body whorl, 51.

LUZON, Zambales Province, *Bur. Sci. 16023 Mitchell:* Rizal Province, Pasay, *Bur. Sci. 14330 Alcasid:* Tayabas Province, Catanauan, *Bur. Sci. 14633 Navarro.* BATAN, Albay Province, *Bur. Sci. 12865 Faustino.* MINDORO, Calapan, *Bur. Sci. 14446 de Mesa.* PALAWAN, Puerto Princesa, *Bur. Sci. 11918 Lopez;* Caramay, *Bur. Sci. 14934 Alcasid, Bur. Sci. 11970 Lopez.* FONDEADO, Palawan Province, *Bur. Sci. 15024 Alcasid.* MINDANAO, *Bur. Sci. 288 Quadras.*

STROMBUS EPIDROMIS Linnæus.

Strombus epidromis LINNÆUS, Syst. Nat. ed. 12 1^2 (1767) 1211; DILLWYN, Cat. Recent Shells 2 (1817) 669; LAMARCK, Anim. sans Vert. 7 (1822) 208; SOWERBY, Thes. Conchyl. 1^1 (1842) 28, pl. 6, fig. 12; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 48, pl. 26, fig. 1; pl. 33, fig. 4; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 19, fig. 54; TRYON, Man. Conchol. 7 (1885) 116, pl. 5, fig. 55; HIDALGO, Cat. Marine Moll. (1904) 135; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Shell ovate; spire short, turreted, sometimes varicose, apex pointed; first five whorls longitudinally ridged, the rest smooth, rather angled, angles noduled, those on the body whorl almost flattened: columella callous; lip broadly expanded, rounded and thickened towards the margin; posterior canal reaching and closely applied to second whorl; body white, freckled with fawn-brown; columella and interior of aperture ivory-white, inner edge of lip and region beyond the columella stained with light brown.

Height, 79 millimeters; breadth, 45; thickness, 28; height of spire, 25; height of body whorl, 54.

POLILLO, Tayabas Province, *Bur. Sci. 12942 Robinson.* MARINDUQUE, Balanacan, *Bur. Sci. 223 Quadras.* GILOTONGAN, Cebu Province, *Bur. Sci. 16374 Boiden.* SITANKAI, Sulu Province, *Bur. Sci. 1255 Seale.*

A fairly large shell of even sculpture, characterized by the broadly expanded lip and dull body color.

STROMBUS VARIABILIS Swainson.

Strombus variabilis SWAINSON in Sowerby, Thes. Conchyl. 1[1] (1842) 27, pl. 6, figs. 9, 13, 14; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 49, pl. 21, fig. 2; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 10, figs. 21*a–d;* TRYON, Man. Conchol. 7 (1885) 117, pl. 6, figs. 59–61; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.

Shell oblong or elongate-ovate; spire exserted, turreted, acuminate, oftentimes varicose near the apex; whorls concave round the upper part, smooth, transversely striated at base, noduled at angles; columella callous, smooth; lip broadly expanded, sinuated at both ends, thickened towards edge; body white, mottled with brown and transversely banded with four or five broken white lines on body whorl; interior of aperture smooth white, columella oftentimes blotched with dark chestnut.

Height, 51 millimeters; breadth, 27; thickness, 18; height of spire, 20; height of body whorl, 31.

LUZON, *Bur. Sci. 14213 Strong:* Tayabas Province, Catanauan, Yuni, *Bur. Sci. 14637 Navarro.* TICAO, Masbate Province, *Cuming.* CEBU, *Hidalgo.* MINDANAO, Surigao, *Elera.*

STROMBUS MINIMUS Linnæus.

Strombus minimus LINNÆUS in Dillwyn, Cat. Recent Shells 2 (1817) 670; SOWERBY, Thes. Conchyl. 1[1] (1842) 28, pl. 6, figs. 4, 5; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 18, fig. 47; TRYON, Man. Conchol. 7 (1885) 117, pl. 6, fig. 62; HIDALGO, Cat. Marine Moll. (1904) 136; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Strombus troglodytes LAMARCK, Anim. Sans. Vert. 7 (1822) 209; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 52, pl. 31, fig. 2.

Shell ovate; spire acuminate, turreted, varicose along apex; body whorl strongly noduled along angle; lip broadly expanded, sinuated at both ends, thickened and somewhat reflected at margin; columella callous; posterior sinus elongate and closely applied to second whorl; body reddish brown, sometimes speckled with yellow throughout or banded with yellow on the body whorl; interior of aperture bright lemon-yellow.

Height, 34 millimeters; breadth, 20; thickness, 14; height of spire, 13; height of body whorl, 21.

LUZON, Tayabas Province, Catanauan, Yuni, *Bur. Sci. 41634 Navarro.* LUBANG, Mindoro Province, *Bur. Sci. 14886 de Mesa.* MARINDUQUE, Boac, Laylay, *Bur. Sci. 236 Quadras.* SIBUYAN, Romblon Province, *Bur. Sci. 77 Lopez.* MINDANAO, Davao Gulf, *Bur. Sci. 87 Ickis:* Zamboanga Province, *Bur. Sci. 15282 Domantay.*

A species of wide range in color variation. Some specimens are plain dark reddish brown, others are speckled with yellowish dots, and the typical forms are banded, one band along the shoulder and one or two across the body whorl. The sculpture is similar to *S. labiosus* with the shells decidedly smaller and the posterior sinus more developed and taking a different direction.

STROMBUS LABIOSUS Gray.

Strombus labiosus GRAY in REEVE, Conchol. Icon. Strombus 6 (1851) pl. 18, fig. 50; TRYON, Man. Conchol. 7 (1885) 116, pl. 5, fig. 51; HIDALGO, Cat. Marine Moll. (1904) 136; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Shell triangular-ovate; spire exserted, acuminate; whorls nine, somewhat rounded, spirally striated, striæ strongest at border of lip, longitudinally ridged; whorls angled, angles slightly tubercled; lip broadly expanded, thickened, deeply radiately striated within; columella callous, slightly wrinkled; body whitish to yellowish fawn, sometimes washed with reddish brown; interior of aperture ivory-white.

Height, 57 millimeters; breadth, 34; thickness, 25; height of spire, 23; height of body whorl, 34.

This species has been reported from Cuming's collection from Cagayan, Mindanao. The only specimen in the Museum's collection, *Bur. Sci. 15256,* has been secured through the kindness of Dr. William J. Clench, of Harvard.

STROMBUS COLUMBA Lamarck.

Strombus columba LAMARCK, Anim. sans. Vert. 7 (1822) 208; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 51, pl. 25, figs. 1, 1*a;* SOWERBY, Thes. Conchyl. 1[1] (1842) 27, pl. 6, figs. 2, 3, 6, 7; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 12, figs. 26*a*, *b;* TRYON, Man. Conchol. 7 (1885) 115, pl. 5, figs. 49, 50; HIDALGO, Cat. Marine Moll. (1904) 135; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Shell oblong-ovate, longitudinally plaited, transversely striated; spire short, varicose; apex pointed; whorls convex with few nodules at angle; lip broadly expanded, heavily striated towards

dorsal margin, interior strongly striated; columella callous with prominent striæ; body white with orange-brown specks or bands, interior stained with rusty brown at throat.

Height, 46 millimeters; breadth, 23; thickness, 18; height of spire, 16; height of body whorl, 31.

PHILIPPINES, *Bur. Sci. 13283 Fulton.* This species was reported from Malanipa Island, *Watson.*

Distinguished by its broadly expanded lip with heavy striations outside and within, and a tinge of rusty brown internally.

STROMBUS VITTATUS Linnæus.

> *Strombus vittatus* LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1211; DILLWYN, Cat. Marine Shells 2 (1817) 671; LAMARCK, Anim. sans Vert. 7 (1822) 207; SOWERBY, Thes. Conchyl. 1[1] (1842) 26, pl. 6, figs. 27–31; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 40, pl. 23, figs. 1, 1*a–b;* REEVE, Conchol. Icon. Strombus 6 (1851) pl. 17, fig. 44; TRYON, Man. Conchol. 7 (1885) 114, pl. 4, figs. 41–44; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.
>
> *Strombus turritus* LAMARCK, Anim. sans Vert. 7 (1822) 212.

Shell elongate, rather fusiform; spire very much exserted, turreted, varicose near apex; whorls grooved at base, margined at upper part, sometimes transversely finely striated, longitudinally ridged; columella callous, narrow, smooth; lip broadly expanded, somewhat winged, radiately striated on inner part; body yellowish, stained or dotted with warm brown, transversely banded with three or four narrow, interrupted, white lines; columella and interior of aperture white.

Height, 65 millimeters; breadth, 29; thickness, 20; height of spire, 0; height of body whorl, 35.

LUZON, Manila Bay, *Bur. Sci. 238 Quadras.* MINDORO, Puerto Galera, *Bur. Sci. 11733 Seale.* SAMAR, *Bur. Sci. 16017 Mitchell.*

STROMBUS MARGINATUS Linnæus.

> *Strombus marginatus* LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1209; DILLWYN, Cat. Recent Shells 2 (1817) 665; LAMARCK, Anim. sans Vert. 7 (1822) 211; SOWERBY, Thes. Conchyl. 1[1] (1842) 28, pl. 6, fig. 17; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 44, pl. 16, fig. 2; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 18, fig. 49; TRYON, Man. Conchol. 7 (1885) 116, pl. 5, figs. 53, 54; HIDALGO, Cat. Marine Moll. (1904) 136; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Shell elongate-obconical; spire short, acuminate, longitudinally ridged, varicose at upper part; whorls eight, rather concave on upper part, angle sharply keeled, spirally faintly lineated, slightly grooved near base; columella callous; lip narrowly ex-

panded, rather thickened, sligthly wrinkled within; body white, spirally 5-banded with wavy reddish-brown streaks; interior of aperture white.

Height, 47 millimeters; breadth, 28; thickness, 22; height of spire, 13; height of body whorl, 35.

The only specimen in the Museum's collection, *Bur. Sci. 13285,* was obtained from H. C. Fulton and is marked 'Philippines.' The first record crediting this species to the Philippines was Reeve's Conchol. Icon. based on Cuming's collections.

STROMBUS SUCCINCTUS Linnæus.

Strombus succinctus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1212; LAMARCK, Anim. sans Vert. 7 (1822) 208; SOWERBY, Thes. Conchyl. 1[1] (1842) 28, pl. 6, figs. 20, 21; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 45, pl. 10, fig. 2; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 17, fig. 43; TRYON, Man. Conchol. 7 (1885) 116, pl. 6, figs. 56, 57; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Strombus accinctus LINNÆUS in Dillwyn, Cat. Recent Shells 2 (1817) 672.

Shell oblong or elongate-ovate; spire exserted, acuminate, turreted; whorls somewhat concave around upper part, longitudinally ridged near apex, sometimes varicose, angles tubercled, angles on body whorls very slight, almost smooth, finely transversely striated; columella callous, smooth, narrow; lip expanded, rather thickened, sinuate at both ends, posterior canal closely applied up to second whorl; body white, mottled throughout with wavy reddish-brown streaks, transversely banded with four or five narrow white strands on body whorl; interior of aperture white, radiately striated towards margin.

Height, 47 millimeters; breadth, 24; thickness, 19; height of spire, 16; height of body whorl, 31.

PHILIPPINES, *Bur. Sci. 13284 Fulton.* LUZON, *Bur. Sci. 11881 Quadras.*

This form presents a wide color range, some specimens being plain reddish brown with faint white bands, others white, mottled with pale-brown streaks. The sculpture is constant, the body whorl almost smooth except for an occasional node at the region of the shoulder.

STROMBUS GIBBERULUS Linnæus.

Strombus gibberulus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1910; DILLWYN, Cat. Recent Shells 2 (1817) 666; LAMARCK, Anim. sans Vert. 7 (1822) 205; SOWERBY, Thes. Conchyl. 1[1] (1842) 31; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 8, figs. 15*a–b;* TRYON, Man.

Conchol. 7 (1885) 121, pl. 8, fig. 85; HIDALGO, Cat. Marine Moll. (1904) 135; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Shell elongate-ovate, attenuated at base; spire exserted, sharp; whorls rounded, unequally gibbous at shoulder, varicose, margined next to suture, transversely striated; columella callous, smooth; interior of aperture finely striated, whitish, sometimes banded with orange or reddish brown, interior of aperture ranging from white to purple.

Height, 50 millimeters; breadth, 24; thickness, 22; height of spire, 19; height of body whorl, 39.

LUZON, La Union Province, *Bur. Sci. 247 Quadras.* MINDORO, Puerto Galera, *Bur. Sci. 15258 Seale.* LUBANG, Mindoro Province, *Bur. Sci. 14883 de Mesa.* ROMBLON, *Bur. Sci. 245 Quadras.* SIBUYAN, Romblon Province, *Bur. Sci. 15259 Lopez.* SOUTH GIGANTES, Iloilo Province, *Bur. Sci. 14672 Montalban.* NEGROS, Occidental Negros Province, Escalante, *Bur. Sci. 246 Quadras.* LEYTE, Cabalian, *Bur. Sci. 15260 Lopez.* CUYO, Palawan Province, *Bur. Sci. 14670, 11937 Lopez.* FONDEADO, Palawan Province, *Bur. Sci. 15047 Alcasid.*

The distorted form is characteristic of this species with the banding and coloration very variable. Sometimes the body is of a plain yellowish tint and at times banded with orange or brown. The interior of the aperture is sometimes pink but varies through all shades to deep purple.

STROMBUS LUHUANUS Linnæus.

Strombus luhuanus LINNÆUS, Syst. Nat. ed. 12 1^1 (1767) 1209; DILLWYN, Cat. Recent Shells 2 (1817) 666; LAMARCK, Anim. sans Vert. 7 (1822) 206; SOWERBY, Thes. Conchyl. 1^1 (1842) 29, pl. 7, fig. 54; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 9, fig. 19; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 39, pl. 27, fig. 1; TRYON, Man. Conchol. 7 (1885) 122, pl. 8, figs. 91, 92; HIDALGO, Cat. Marine Moll. (1904) 136; IWAKAWA, Cat. Jap. Moll. (1919) 87; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Shell obconical, solid; spire short, acuminate, few last whorls slightly varicose, whorls smooth, faintly grooved at upper part close to suture; body whorl somewhat humped at shoulder; columella straight, aperture narrow; lip slightly wrinkled within, somewhat expanded, straight, sinuate at upper part; body whitish, transversely banded with brown wavy streaks; columella purple black; interior of aperture deep flesh-colored.

Height, 60 millimeters; breadth, 32; thickness, 26; height of spire, 12; height of body whorl, 47.

LUZON, Ilocos Norte Province, Currimao, *Bur. Sci. 12183 Smith:* Batangas Province, Layia, *Bur. Sci. 12843 Herre:* Tayabas Province, Catanauan, Yuni, *Bur. Sci. 14639 Navarro.* MINDORO, Puerto Galera, *Bur. Sci. 14552 Alcasid, Bur. Sci. 14595 Teves.* LUBANG, Mindoro Province, *Bur. Sci. 14881 de Mesa.* ROMBLON, San Fernando, *Bur. Sci. 12045 Hayne.* BOHOL, *Bur. Sci. 16013 Mitchell.* DINAGAT, Surigao Province, *Bur. Sci. 12196 Lopez.* LINAPACAN, Palawan Province, *Bur. Sci. 11912 Lopez.* PALAWAN, Bacuit, *Bur. Sci. 14221 Merin, Cinco, and Worin;* Caramay, *Bur. Sci. 14932 Alcasid;* Binduyan, *Bur. Sci. 14988 Alcasid.* BALABAC, *Bur. Sci. 212 Quadras.*

Can be distinguished by the obconical form of the shell, the dark purple of the columella, and the bright flesh color of the aperture. Widely distributed in the Philippines, usually found on sandy-muddy flats.

STROMBUS DENTATUS Linnæus.

Strombus dentatus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1213; DILLWYN, Cat. Recent Shells 2 (1817) 674; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 9. fig. 17; TRYON, Man. Conchol. 7 (1885) 118, pl. 6, figs. 68, 70; pl. figs. 67–72.

Strombus plicatus LAMARCK, Anim. sans Vert. 7 (1822) 210; KIENER, Icon. Cop. Viv. Strombus 4 (1843) 62, pl. 31, figs. l*a*, *b*; SOWERBY, Thes. Conchyl. 1[1] (1842) 30, pl. 7, fig. 56.

Shell elongate; spire turreted; whorls transversely striated, elongately ridged, well developed at angle, those on body whorls pronounced, rather compressed; columella thick, somewhat wrinkled; lip rather expanded, thickened; interior of aperture yellowish-brown, finely striated towards margin; body whitish to yellowish, speckled throughout with gray oftentimes admixed with brown, encircled with several narrow white bands; external edge of lip rusty brown.

Height, 39 millimeters; breadth, 20; thickness, 18; height of spire, 13; height of body whorl, 26.

LUBANG, Mindoro Province, *Bur. Sci. 14445 de Mesa.* MARINDUQUE, Boac, *Bur. Sci. 14668 Quadras.* MACTAN, Cebu Province, *Bur. Sci. 14205 Smith.* SOUTH GIGANTE, Iloilo Province, *Bur. Sci. 12649, 12704 Montalban.* FONDEADO, Palawan Province, *Bur. Sci. 15035 Alcasid.*

There is a wide range of variation in this species. Sometimes the body tubercles are not well developed, and there are cases where the longitudinal striæ are totally absent anteriorly, approaching the case in *S. urceus*. Coloration also varies from

white with gray specks to a total gray or warm brown with a few whitish spots or bands.

STROMBUS URCEUS Linnæus.

Strombus urceus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1212; DILLWYN, Cat. Recent Shells 2 (1817) 673; LAMARCK, Anim. sans Vert. 7 (1822) 210; SOWERBY, Thes. Conchyl. 1[1] (1842) 30, pl. 7, figs. 34–37, 41, 42; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 60, pl. 15, fig. 2; pl. 30, figs. 2, 3; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 11, figs. 24*a–c;* TRYON, Man. Conchol. 7 (1885) 118, pl. 6, figs. 65–67; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.

Shell oblong or elongate-ovate, transversely striated at base; spire exserted, acuminate, turreted; body whorl noduled at angle; columella callous, narrow, slightly wrinkled; lip somewhat expanded, sinuate at anterior part, anterior canal truncate, upturned; body white to yellowish, mottled with gray or brown often arranged in bands; interior of aperture radiately striated, orange-yellow splashed with dark chestnut-brown.

Height, 48 millimeters; breadth, 23; thickness, 19; height of spire, 14; height of body whorl, 35.

LUZON, Ilocos Norte Province, Currimao, *Bur. Sci. 14207 Smith:* Bataan Province, Bagac, *Bur. Sci. 234 Quadras:* Tayabas Province, Catanauan, Yuni, *Bur. Sci. 14638 Navarro.* LUBANG, Mindoro Province, *Bur. Sci. 14880 de Mesa.* BANTAYAN, Cebu Province, *Bur. Sci. 106 Lopez.* GILOTONGAN, Cebu Province, *Bur. Sci. 16375 Boyden.* LEYTE, *Bur. Sci. 14214 Abad.* CULION, Palawan Province, *Bur. Sci. 12040 Lopez.* CUYO, Palawan Province, *Bur. Sci. 11972, 12134 Lopez.* PALAWAN, Puerto Princesa, *Bur. Sci. 11979 Lopez;* Caramay, *Bur. Sci. 12062 Lopez.* BALABAC, *Bur. Sci. 235 Quadras.*

The form is similar to *S. dentatus* and may be distinguished by its lighter body color, dark gray near the apex and at the anterior tip, and by the peculiar color of the aperture. In some specimens the aperture is intense dark gray while in others it may be plain orange.

STROMBUS FLORIDUS Lamarck.

Strombus floridus LAMARCK, Anim. sans Vert. 7 (1822) 211; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 63, pl. 32, figs. 1, 1*a–c;* REEVE, Conchol. Icon. Strombus 6 (1851) pl. 7, figs. 11*a–d;* TRYON, Man. Conchol. 7 (1885) 119, pl. 7, figs. 73–76, 80, 83; HIDALGO, Cat. Marine Moll. (1094) 135; FAUSTINO, Bur. Sci. Monog. 25 (1928) 212.

Strombus mutabilis SWAINSON in Sowerby, Thes. Conchyl. 1[1] (1842) 29, pl. 7, figs. 40, 45–47, 49, 52.

Shell ovate, thick; spire short, spirally ridged; ridges most prominent at base, deeply grooved near the sutures; whorls exserted, somewhat angled; angles obliquely tubercled, those on body whorl few and gently sloping anteriorly; columella thickened, finely wrinkled throughout; aperture oblong; lip almost straight, thickened, finely striated; interior of aperture scarlet pink; body whitish or yellowish, blotched, dotted or banded with pale orange-brown.

Height, 36 millimeters; breadth, 19; thickness, 17; height of spire, 11; height of body whorl, 25.

LUZON, Bataan Province, *Bur. Sci. 11705 Lopez;* Moron, *Bur. Sci. 240 Quadras.* CEBU, *Bur. Sci. 216 Quadras.* MINDANAO, Cagayan Province, Salay, *Bur. Sci. 224 Quadras:* Zamboanga Province, Zamboanga and Dapitan, *Hidalgo.* MINDORO, Naujan, *Hidalgo.* BALANACAN, Marinduque Province, Hidalgo. TICAO, Masbate Province, and BOHOL, *Cuming.* SAMAR, *Jagor.* BALABAC, *Hidalgo.*

A small specimen with the form of *elegans* and *dentatus* especially in the structure of the aperture, differing only in the shorter spire and the stout body.

STROMBUS ELEGANS Sowerby.

Strombus elegans SOWERBY, Thes. Conchyl. 1[1] (1842) 30, pl. 7, figs. 43, 48; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 17, figs. 41*a*, *b;* HIDALGO, Cat. Marine Moll. (1904) 135; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Strombus dentatus var. *eurythrinus* CHEMNITZ in Tryon, Man. Conchol. 7 (1885) 119, pl. 7, figs. 69–71.

Shell elongated; spire rather exserted, transversely striated, faintly elongately ridged, somewhat developed at angle; columella thick; lip somewhat expanded and thickened; interior of aperture purple to warm brown, densely striated; body whitish, dotted or banded with brown.

Height, 33 millimeters; breadth, 16; thickness, 14; height of spire, 13; height of body whorl, 20.

PHILIPPINES, *Bur. Sci. 13280 Fulton.*

Similar to *S. dentatus,* with the shell more elongate and fusiform and the spire generally turreted. The body sculpture is less pronounced, with the shoulder tubercles as low ridges, the longitudinal striæ almost entirely gone, and the transverse striations pronounced towards the lip.

STROMBUS RUGOSUS Sowerby.

Strombus rugosus SOWERBY, Thes. Conchyl. 1[1] (1842) 30, pl. 7, figs. 58, 60; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 9, fig.

16; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Strombus corrugatus ADAMS and REEVE, Voy. Samarang (1850) 35, pl. 10, fig. 19.

Shell oblong or elongate-ovate; spire rather exserted; transversely striated, faintly elongately ridged; angles noduled; lip somewhat expanded and slightly thickened, sinuated at the anterior part; columella callous; body creamy white, transversely banded with faint flesh strands; interior of aperture faint rusty brown, radiately striated towards the lip.

Height, 26 millimeters; breadth, 12; thickness, 10; height of spire, 10; height of body whorl, 16.

Similar to S. *elegans* in sculpture and easily taken as a smaller variety of that species, differing, however, in being stouter and of lighter color. The only specimen in the Museum's collection, *Bur. Sci. 13083,* was obtained from H. C. Fulton.

STROMBUS SAMAR Chemnitz.

Strombus samar CHEMNITZ, Conch. Cab. 10 (1769–1829) 221, pl. 157, fig. 1503; DILLWYN, Cat. Recent Shells 2 (1817) 674; TRYON, Man. Conchol. 7 (1885) 121, pl. 8, fig. 88; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Srombus tridentatus LAMARCK, Anim. sans Vert 7 (1822) 209, KIENER, Icon. Coq. Viv. Strombus 4 (1843) 64, pl. 26, fig. 2.

Strombus dentatus GMELIN (not Linnæus) in Sowerby, Thes. Conchyl. 1[1] (1842) 31, pl. 9, figs. 86, 87.

Strombus samarensis CHEMNITZ in Reeve, Conchol. Icon. Strombus 6 (1851) pl. 19, figs. 53*a*, *b;* HIDALGO, Cat. Marine Moll. (1904) 137.

Shell elongate-ovate; spire exserted, acuminate; whorls convex, longitudinally ridged, smooth, rather unequally gibbous; columella callous, narrow; lip abbreviately expanded, dentated at anterior end; body creamy-white splashed with light-brown wavy streaks or blotches; interior of aperture radiately striated towards the lip, dark chestnut-brown; columella white.

Height, 52 millimeters; breadth, 22; thickness, 19; height of spire, 20; height of body whorl, 31.

PHILIPPINES, *Bur. Sci. 13281 Fulton.*

This form is very seldom encountered. It can be easily distinguished by its elongate shape with slightly unevenly swelling whorls and the three lobes at the base of the slightly expanded lip.

STROMBUS BULBULUS Sowerby.

Strombus bulbulus SOWERBY, Proc. Zool. Soc. (1842) 144; Thes. Conchyl. 1[1] (1842) 32, pl. 9, figs. 81–83; REEVE, Conchol. Icon.

Strombus 6 (1851) pl. 6, fig. 8*a*, *b;* TRYON, Man. Conchol. 7 (1885) 121, pl. 8, fig. 86; HIDALGO, Cat. Marine Moll. (1904) 134; FAUSTINO, Bur. Sci. Monog. 25 (1928) 211.

Shell subcylindrical, smooth, gibbously swollen, base sulcate; body freckled and oftentimes banded with chestnut; aperture dark purple, finely striated within.

Height, 33 millimeters; breadth, 15; thickness, 13; height of spire, 11; height of body whorl, 23.

MINDANAO, Surigao Province, *Bur. Sci. 239 Quadras.*

A species very seldom encountered. The only specimen in the Museum's Cabinet was part of the Quadras collection. This form has the general shape of *S. gibberulus.*

STROMBUS TEREBELLATUS Sowerby.

Strombus terebellatus SOWERBY, Thes. Conchyl. 1[1] (1842) 31, pl. 9, figs. 84, 85; KIENER, Icon. Coq. Viv. Strombus 4 (1843) 66, pl. 18, fig. 2; REEVE, Conchol. Icon. Strombus 6 (1851) pl. 6, fig. 10 *a, b;* TRYON, Man. Conchol. 7 (1885) 121, pl. 8, fig. 87; HIDALGO, Cat. Marine Moll. (1904) 137; FAUSTINO, Bur. Sci. Monog. 25 (1928) 213.

Shell elongated, thin, smooth; spire exserted; whorls rounded, alternately gibbously swollen; columella narrow; lip slightly expanded, somewhat truncated at anterior part; body yellowish, mottled with wavy reddish-brown streaks; interior of aperture white, very faintly radiately striated.

Height, 33 millimeters; breadth, 11; thickness, 10; height of spire, 14; height of body whorl, 19.

MARINDUQUE, Boac, Laylay, *Bur. Sci. 773 Quadras.*

An elongate, thin, smooth shell, having the form of *terebellum,* with the lip truncated anteriorly.

Genus ROSTELLARIA Lamarck

Shell fusiform, somewhat turreted; base extended into an acute rostral canal; lip rather broad, entire or dentate; posterior canal usually short, ascending and closely applied to spire.

Key to the Philippine species of Rostellaria.

a^1. Shell large, whorls smooth.
  b^1. Anterior canal short, straight .... *R. martini.*
  b^2. Anterior canal long .... *R. fusus.*
a^2. Shell small; whorls plicated.
  b^1. Posterior canal long, decumbent .... *R. fissurella.*
  b^2. Posterior canal short, curving outward .... *R. crispata.*

ROSTELLARIA MARTINI Marrat.

Rostellaria martini MARRAT in Tryon, Man. Conchol. 7 (1885) 128, pl. 11, fig. 34; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 215.

Shell fusiform, spire exserted, acuminate; whorls smooth, rounded; columella callous, arched; lips slightly expanded, 7-dentate, conspicuously channeled above but not reaching first suture; anterior canal short, straight, light yellowish brown; interior of aperture white.

Height, 137 millimeters; breadth, 47; thickness, 37; height of spire, 57; height of body whorl to tip of canal, 80.

MARINDUQUE, Masiga, *Bur. Sci. 944 Quadras.*

This is the largest species of *Rostellaria* in the Philippines. The museum's specimen is probably the one referred to in Hidalgo's report.

ROSTELLARIA FUSUS (Linnæus).

Strombus fusus LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1207; DILLWYN, Cat. Recent Shells 2 (1817) 654.

Rostellaria rectirostris LAMARCK, Anim. sans Vert. 7 (1822) 192; KIENER, Icon. Coq. Viv. Rostellaria 4 (1843) 5, pl. 2, fig. 1.

Rostellaria rectirostrum LAMARCK in Sowerby, Thes. Conchyl. 1[1] (1842) 22, pl. 5, figs. 8, 10.

Rostellaria fusus LINNÆUS in Reeve, Conchol. Icon. Rostellaria 6 (1851) pl. 2, fig. 5; TRYON, Man. Conchol. Icon. 7 (1885) 128, pl. 10, fig. 17; pl. 11, fig. 21; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.

This species very closely resembles *R. martini,* differing only in being slender, with the anterior canal very much longer. There is no specimen in the museum's collection, and the writer had no opportunity to examine one. This species was reported by Hidalgo from Lubang Island, Mindoro Province, and from Balugo, Marinduque.

ROSTELLARIA FISSURELLA (Linnæus).

Strombus fissurella LINNÆUS, Syst. Nat. ed. 12 1[2] (1767) 1212; DILLWYN, Cat. Recent Shells 2 (1817) 672; SOWERBY, Thes. Conchyl. 1[1] (1842) 26, pl. 8, figs. 64, 65.

Rostellaria fissurella LINNÆUS in Lamarck, Anim. sans Vert. 7 (1822) 194.

Strombus cancellatus LAMARCK, Anim. sans Vert. 7 (1822) 212.

Rostellaria cancellata LAMARCK in Kiener, Icon. Coq. Viv. Rostellaria 4 (1843) 9, pl. 3, fig. 3; REEVE, Conchol. Icon. Rostellaria 6 (1851) pl. 3, fig. 10; TRYON, Man. Conchol. 7 (1885) 129; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.

Shell fusiform; spire turreted; whorls longitudinally plicated, spirally striated; aperture oval; posterior canal running up and closely applied to spire; lip slightly expanded, thickened-crenulate, faintly radiately striated within; columella callous, thickened; body yellowish brown, often banded with fawn; columella and interior of aperture white.

Height, 37 millimeters; breadth, 15; thickness, 11; height of spire, 17; height of body whorl, 20.

CEBU, *Bur. Sci. 10898 Quadras.* MINDANAO, Zamboanga, *Bur. Sci. 15279 Domantay, Bur. Sci. 15280 Casey.* In Zamboanga dredged in sandy-muddy bottom at 6 fathoms.

This form is slightly larger than *R. crispata,* and a bit more compressed, with the posterior canal gently rising and sliding backwards. These two species were placed by Tryon under the subgenus *Rimela.*

ROSTELLARIA CRISPATA (Sowerby).

Strombus crispatus SOWERBY, Thes. Conchyl. 1[1] (1842) 26, pl. 8, figs. 62, 63; Proc. Zool. Soc. London (1842) 143.

Rostellaria crispata SOWERBY in Kiener, Icon. Coq. Viv. Rostellaria 4 (1843) 10, pl. 4, fig. 12; REEVE, Conchol. Icon. Rostellaria 6 (1851) pl. 3, fig. 82 *b;* TRYON, Man. Conchol. 7 (1885) 129, pl. 10, fig. 19; HIDALGO, Cat. Marine Moll. (1904) 139; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.

Shell fusiform; spire turreted, acuminate; whorls spirally striated, longitudinally plicated; aperture oval, posterior canal short, running up and sharply curving outwards; lip slightly expanded, somewhat thickened and crenulate at margin; columella callous, slightly curved; body yellowish brown with stripes or blotches of rusty brown; interior of aperture chestnut; columella and lip white.

Height, 22 millimeters; breadth, 10; thickness, 7; height of spire, 9; height of body whorl, 13.

CEBU, *Bur. Sci. 2401 Quadras.* MINDANAO, Zamboanga Province, Dapitan, *Bur. Sci. 777 Quadras.*

This species is very much smaller than the preceding one, of deeper body color, and with a short, sharply curved, posterior canal.

Genus SERAPHS Montfort

Shell elongate, subcylindrical; spire short; body whorl prominent, smooth; aperture elongate, narrowing posteriorly. Lip simple, thin.

SERAPHS SUBULATUM (Lamarck).

Terebellum subulatum LAMARCK, Anim. sans Vert. 7 (1822) 410; Zool. Voy. Samarang (1850) 36, pl. 9, fig. 6; SOWERBY, Thes. Conchyl. 3 (1866) 80, pl. 218, figs. 4, 5; TRYON, Man. Conchol. 7 (1885) 131, pl. 11, figs. 27–30.

Seraps subulatum LAMARCK in Faustino, Bur. Sci. Monog. 25 (1928) 214.

Terebellum punctatum CHEMNITZ in Reeve, Conchol. Icon. Terebellum 14 (1864) pl. 1, figs. 1*a–g;* HIDALGO, Cat. Marine Moll. (1904) 140; FAUSTINO, Bur. Sci. Monog. 25 (1928) 214.

Shell elongate, subcylindrical, thin, smooth; spire short; body whorl very large; aperture elongate, narrow posteriorly, somewhat dilated anteriorly, anterior end truncate, lip simple, thin columella slightly callous, straight; body white, variegated with reddish-brown specks or dots.

Height, 55 millimeters; breadth, 13; thickness, 11; height of spire, 12; height of body whorl, 43.

LUZON, Tayabas Province, Catanauan, Yuni, *Bur. Sci. 14640 Navarro.* MARINDUQUE, Boac, Laylay, *Bur. Sci. 991 Quadras.* SAMAR, Catbalogan, *Bur. Sci. 12804 Schenck.* MINDANAO, Zamboanga Province, Zamboanga, *Bur. Sci. 15281 Casey.* PALAWAN, Bacuit, *Bur. Sci. 12058 Merin, Cinco, and Worin.*

In general form the shell of this species seems to have no affinity with the other members of the family. The connection was established only on collecting and observing live specimens. The animals show the same anatomical details and behavior.

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OUTLINE REVIEW OF PHILIPPINE ARCHAEOLOGY BY ISLANDS AND PROVINCES

By H. OTLEY BEYER

Of the Museum and Institute of Archaeology and Ethnology University of the Philippines

TWENTY-TWO PLATES AND TWO TEXT FIGURES

INTRODUCTION

A geographical outline of what has been actually accomplished in Philippine archaeological exploration has long been needed. An adequate account of the finds themselves would easily fill two or three printed volumes, but the present paper is merely an effort to furnish a guide outline of actual accomplishment, based either on personal examination of specimens found or on reported finds of a reliable nature. The areas discussed are arranged geographically, from north to south as far as possible; and, for convenience, some closely related outside areas, not properly belonging to the Philippine Archipelago, are also included.

The authorities for the various finds are usually cited, and, where no names are mentioned, it may be generally assumed that the finds were made by myself or by workmen operating under my direction. So far as practicable, the data under each geographical heading have been arranged chronologically or typologically, but this arrangement has not been rigidly adhered to if inconvenient. The object has been merely to furnish the essential information concerning each province or island in the briefest practical way, with uniformity of presentation followed only where convenient under the circumstances.

History.—Only two important archaeological investigations had been carried out prior to 1926: (1) Alfred Marche's exploration of Marinduque Island, from April to July, 1881; and

(2) Dr. Carl E. Guthe's work in the central Visayan Islands, 1922–1924. While many accidental finds had been recorded from time to time, and a few burial-caves and other sites had been casually explored by European or local scientists, no really systematic work had been done anywhere, except for the efforts of Marche and Guthe. M. L. Miller and F. D. Burdett had explored burial mounds in the Babuyan Islands; E. B. Christie had collected from the burial-caves around Dapitan and in the Zamboanga Peninsula; Miller and Parker, similarly from northern Panay; and Hartendorp, from eastern Samar. Dean C. Worcester had collected celadon porcelains from burial-sites in Cebu, and some of his employees also from Samar, Siquijor, and other islands; while E. de Mitkiewicz collected numerous jars and other ceramics from both Cebu and Luzon. None of this work was very scientifically done, however, and the chief results were miscellaneous collections of ceramics and skeletal material.

In 1923–1924 I attempted a compilation of all known data on true Philippine Stone-Age finds, and after a very diligent search of the literature, as well as an examination of all rumored finds, I was able finally to accumulate data on some 60 implements that seemed to be genuine prehistoric Stone-Age artifacts. Of these, I acquired or personally examined about 30 real Neolithic implements, scattered over a wide geographic range, from Davao to northern Luzon. Most of these tools were obviously Middle or Late Neolithic in type, but they were sufficient to show that we had a true Late Stone-Age population here, even if the remains were scarce and widely scattered. Doctor Guthe's work had added only six or seven specimens to the list of known Neolithic artifacts—the first two Visayan Islands specimens being the very good implements obtained in 1920 by Dr. Warren D. Smith from a cave in Masbate. However, our combined efforts offered sufficient refutation of the commonly repeated statement in books about the Philippines prior to 1920 that the Islands had never had a true Stone-Age population.

Such was the state of affairs down to 1926, when the fortuitous discoveries at the Novaliches Dam (Rizal Province) ushered in a new era in Philippine archaeology. Since that time systematic work has been going on continuously, except as interrupted by the war during the greater part of 1942–1945. Naturally, however, there have been variations in the degree

of activity, and my own chief occupation with the work may be classified briefly as follows:

1. Rizal Province Archaeological Survey (1926–1930).
2. Visayan Islands collecting (1929–1933, 1936–1939, 1941, especially).
3. Batangas Archaeological Survey (1932–1941).
4. Special Pugad-Babuy (Bulakan) collection (1933–1938, especially).
5. Special Santa Mesa and Kubao collections, Rizal Province (1935–1940).
6. Several small collections at intermediate intervals (see especially Pampanga, Busuanga, Camarines Norte, Cavite, Zambales, Sulu, and other places).

Useful comparative data and material were obtained during the three meetings of our Far Eastern Prehistoric Congress (Hanoi, 1932; Manila, 1935; and Singapore, 1938—the 4th planned meeting at Hongkong, 1941, being prevented by the war). Also from the visits of various noted foreign scientists to our sites (especially during and after the F. E. P. C. meeting at Manila in 1935). The importance of correlating Philippine archaeological data with those from South China, Hongkong, and Formosa, on the north; Indo-China, on the west; the Pacific islands, on the east; and from Borneo, the Dutch East Indies, and the Malay Peninsula, on the south, was especially brought out during these visits and Congress meetings.

It is obviously not practical to add all of these areas (especially the more remote ones) to our present outline; but, for convenient comparative reference, I have included South China, Hongkong, and Formosa, on the north, and Borneo and Celebes on the south. The outline itself is more or less self-explanatory.

It is further planned to publish, in the near future, more extended accounts of some of the more interesting sites mentioned in this outline, with full discussion of the collections, and an attempt at interpreting their significance. Such papers will be accompanied by adequate illustrations and pertinent bibliographic data, which the plan of the present outline necessarily excludes.

Chronology and horizon lists.—The oldest artifacts, or man-made stone implements, yet found in the Philippines have been dated by associated fossils as coming within the Mid-Pleistocene geologic period—a time that most modern geologists estimate to be not less than 250,000 to 300,000 years ago. This oldest horizon has, so far, been identified only in Rizal, Bulacan, Batangas, and Davao Provinces.

The full list of subsequent Stone-Age and later horizons may be tabulated as follows (the tentative dates given to be regarded as fair estimates only):

Palaeolithic (Old Stone Age):
- Early type (Middle Pleistocene); as above.
- Later type (Late Pleistocene); between 150,000 and 50,000 B. C.

Mesolithic (Middle Stone Age)—(Early to Late Post-Pleistocene):
- Large implement culture; perhaps 20,000 to 15,000 B. C.
- Semimicroliths and microliths: 12,000 to 8,000 B. C.

Neolithic (New Stone Age)—(Recent):
- Protoneolithic (Bacsonian); perhaps 5000–4000 B. C.
- Early (round or oval axe-adze cultures); 4000–2250 B. C.
- Middle (shouldered and ridged axe-adze cultures); (2250–1750 B. C.).
- Late (rectangular and trapezoidal adze cultures); (1750–250 B. C.).
  - First phase (Early Nephrite Culture); (1750–1250 B. C. ?).
  - Second phase (transitional types dominant); (1250–800 B. C.).
  - Third phase (early "stepped" types, etc.); (800–500 B. C.).
  - Fourth phase (fully stepped implements; with sawing, hole-boring, and "jade-cut" jewelry, etc.; with some imported Greek-culture beads and coins); 500–200 B. C.

Bronze Age: (Mixed with 2nd to 4th phase of the Late Neolithic); about 800–250 B. C.

Prehistoric Iron Age: (about 250–200 B. C. to 9th century A. D.):
- Early (incised pottery, without slip covering); (200 B. C. to about 300 A. D.).
- Late (slip-covered and molded pottery); (about 300–850 A. D.).

Jar-burial culture: (Contemporary with Late Iron Age); about 300–850 A. D. (Pre-Porcelain, in Philippines).

Porcelain Age: (Pre-Spanish: 9th to 16th century A. D.):
- Early monochrome period (Tang and Early Sung); 9th–12th century.
- Later monochrome period (Southern Sung and Yúan); 13th–14th century.
- Early Ming period (15th and early 16th centuries).
- Late Ming period (late 16th and early 17th centuries).

Spanish period remains: (Historic; 17th–19th century):
- Early (1565 to British occupation in middle 18th century).
- Late (1765 to 1898).

Source of data.—Most of the facts contained in the present paper have been derived from two major sources: First, a six-volume work compiled by myself and entitled "Philippine Archaeology" (1926–1947), containing 55 separate papers a list

of which may be added as an appendix to the present "Outline." Second, a two-volume work by myself entitled "Chinese and Southest Asia Ceramic Wares found in the Philippines" (1939–1940), containing approximately 800 typewritten pages. In addition to these two manuscript works, the catalogues of the various collections have been utilized where necessary. Any citation of data from other authors is duly credited in the text.

A. SOUTH CHINA TO LUZON

1. *Hoifung area; Kwangtung Province, South China:*
   - Early Neolithic (oval axe-adze culture). (Advanced types.)
   - Middle Neolithic (shouldered and early ridged axe-adze forms); characteristic types, most common in site.
   - Late Neolithic: Early and transitional type only; a few stepped specimens with ground butts, no sawing; stone spearheads in two areas, but only a few rare specimens are perforated. (No jade culture found.)
   - Neolithic cord-marked and net-marked pottery in part of area.
   - Chou to Han stamped or molded hard pottery (scarce, and limited in area).
   - *Workers.*—D. J. Finn and R. Maglioni.

2. *Hongkong, Lamma Island, and New Territory areas:*
   - Limited areas of Late Palaeolithic and large implement Mesolithic cultures.
   - Early Neolithic (widely scattered, and including some primitive Bacsonian types).
   - Middle and Late Neolithic types (limited distribution, and specimens scarce); including a few shouldered specimens, several transitionals, and two or three fully stepped specimens—but not sawn. (With limited jade culture, and hole-boring; both scarce.) Also quartz-disk culture.
   - Neolithic cord-marked and net-marked pottery in Lamma Island area; scarce elsewhere.
   - Chou to Han stamped and molded hard pottery (plentiful); with limited bronzes (including celts and spearheads, similar to Indo-China types and to Batangas).
   - Early glazed porcellaneous wares (Han to Tang); in considerable quantities, in several different areas. (Many with potter's marks on base.)
   - Early Ming sherds or midden dumps in certain specific areas (usually marking early European trade-centers and residence areas).
   - *Workers.*—C. M. Heanley, J. L. Shellshear, D. J. Finn, W. Schofield, and R. Maglioni.

3. *Formosa Island (Taiwan):*
   - (Certain possible palaeoliths found with Pleistocene mammalian fossils; of rhinoceros, stegodon, etc. (See notes by I. Hayasaka, 1942.)

Early Neolithic, (round or oval axe-adze culture); plentiful at certain limited areas in northern part of Island.

Middle Neolithic (shouldered and ridged axe-adze forms); typical of Maruyama Site, Taihoku, and a few other places.

Late Neolithic: The usual early trapezoidal adze forms, and a few transitional stepped forms; spearheads; limited hole-boring, but sawn forms absent or very scarce. (Jade culture present in specific areas, according to Kano.)

Bronze-Age remains scarce (but known from limited specific areas in several parts of Island).

Neolithic pottery reported, but authenticity doubtful.

(Records lacking for true Iron-Age and Porcelain-Age sites; but some undoubtedly exist, and many rare Iron-Age beads are found treasured among the pagan mountain peoples, who are close kin to the pagans of northern Luzon.)

Chinese historical records indicate Visayan settlements in southern Formosa as early as the 12th century or before (see Hirth and Rockhill; etc.).

Workers.—T. H. Linn, N. Utsurikawa, Erin Asai, Tadao Kano, and others.

4. *Samasama Island (Kasho-tō) near eastern Formosa coast):*

Late Neolithic (with jade-culture ornaments, and some bronze).

Jar-burial culture (of the Batanes-Babuyan type?).

Worker.—Tadao Kano.

5. *Botel Tobago Island (Kōtō-sho):*

Early Neolithic (oval adze culture); a few specimens only.

Late Neolithic; regular plain-backed rectangular and trapezoidal axe-adze forms only; no shouldered or stepped forms yet found, but limited jade culture present.

Jar-burial culture (similar to Batanes-Babuyan type).

Chinese historical records of 12th–13th century refer to this Island as "T'an-ma-yen" (or, in Cantonese, "Tam-ba-gan"); see Hirth and Rockhill.

(Natives show cultural and linguistic kinship to the Ivatan; but in physical type, and in their stone-walled terrace culture, they most resemble the Bontok group of northern Luzon.)

Workers.—Erin Asai, R. Torii, Tadao Kano, and K. E. Stewart. (For stone implements, see also E. R. Leach, 1938.)

6. *Batanes Islands (sites examined all being on Batan Island):*

(No true Stone-Age remains have yet been recovered; and no bronze, but certain very old ornaments of Bronze-Age forms, and certain imported Greek-culture and Bactrian beads, may go back to a Bronze or very early Iron-culture period.)

Jar-burial culture.—First discovered and explored by Pio Montenegro in 1931–1935, and is perhaps the oldest jar-burial type in the Philippines—going back to the early centuries of the Christian Era. The jars are larger and of somewhat different shape than those found in the Babuyan Islands and southwards. Several large-size burial-jars were first excavated in

the site known as "Itbud," in the district of Uyugan, some distance to the southeast of Ivana. Five other localities were later investigated, and two of them produced typical jar-burials from the peculiarly shaped mounds known as *pada-paday* by the local residents. The most interesting specimens were found in 1932 at the small site known as "Chanarian," in the north central part of the Island.

The jar containing the body was usually first put into an excavation—sufficiently deep so that the top of the cover was seldom much above the ground level—and then the hole was filled in and covered with an earthen mound of some size (in the Babuyan Islands being still further covered with a stone cairn). In most of the jars found the bones were already wholly disintegrated, but in a few cases the teeth and some sizable bone-fragments still remained. The jars are all made of a thick half-baked hard pottery or a medium-soft stoneware, doubtless of local manufacture. They rarely contain ornaments or other durable objects besides the body itself, though occasionally a few small beads and other ornaments have been found.

Iron-Age sites.—In two of the sites explored by Montenegro a very different type of burial that seems to belong to a rather late but pre-Porcelain Iron Age was found. Here quantities of beads of Iron-Age types (including some typical *pan͠go*), some small iron tools or weapons, pieces of common pottery, and several very interesting gold ornaments, have been recovered. At Uyugan, in November, 1933, a similar grave was found that seems to be transitional to the Early Porcelain Age—seemingly containing elements from both cultures.

Early Porcelain-Age sites.—The true Porcelain-Age graves of Batan Island contain some of the earliest porcelain pieces yet found in the Philippines. Only in parts of the Sulu Archipelago, and in Site 7 of the Rizal Province exploration have equally old specimens turned up. (This type of ware is characterized by an unusual proportion of white or light-colored pieces with incised or impressed designs of Late Tang and Early Sung styles. Some of them are probably Yü-yao ware from Chekiang.) The midden fragments from such sites also contain a good many examples of thin or medium-thin stoneware jars, of various sizes, which also appear to be of Late Tang or Early Sung date.

Later Porcelain-Age and historic finds.—Several scattered accidental finds of celadon dishes and other pre-Spanish ceramic pieces, and some interesting heirloom pieces from the early Spanish period, are known not only from Batan Island itself but also from Itbayat and Sabtan. Some curious bead neck-ornaments, gold earrings and headbands, of undoubted pre-Spanish date, are still preserved among some of the wealthier families. (Search of old records by Dampier and the early Dominican missionaries should be made for references to pre-Spanish culture.)

Workers.—Otto Scheerer, Pio Montenegro, Tadao Kano. (For additional data on Batan Island, see Addendum.)

7. *Babuyan Islands* (*Camiguin, Dalupiri, Fuga, Calayan, Babuyan Claro*):

(No true Stone-Age or Bronze-Age remains yet recorded.)

Early or Middle Iron-Age sites.—Some quite Early Iron-Age remains have been found, on Camiguin Island especially. Some lumbermen, working there, have reported frequent finds of typical Iron-Age burials, in the shallow excavations made for establishing their camps, in the now-forested eastern part of the Island. The descriptions given by several of the men indicate that quantities of beads, bracelet fragments, potsherds, pieces of iron tools and weapons, and other objects, were found in these graves. The few specimens that I have seen were almost identical with the Iron-Age remains from Sites A, C, and H, in Rizal Province. (Further investigation should be made here whenever opportunity offers.)

Jar-burial culture.—On all of the Babuyan Islands (except possibly Fuga) typical early jar-burial remains have been found. Their presence is usually indicated by stone cairns or earthen mounds—although in some inhabited areas cultivation has eliminated the earthen mounds and the local people have sometimes carried away the stones from the cairns (called "kunukun") for building purposes. The least disturbed remains have been found on Camiguin, Dalupiri, and Babuyan Claro—where the present population is very sparse—but literally hundreds of jar-burials are said to still exist in Calayan Island, where the population is considerably larger. (Parts of Fuga Island are also said, by Willcox, to contain jar-burials, but this report has not been satisfactorily verified.)

The first serious exploration was made by Merton L. Miller, on Camiguin Island in 1910, reported in a brief paper.[1] Many mounds were examined but only a few were excavated and the remains brought to Manila. Practically all of the jars were found broken in the ground, and the skeletal remains entirely disintegrated. An interesting variation from Batan was the finding of smaller pieces of native pottery (usually with stands and molded rims) buried alongside the larger jars. Several of these pieces were recoverd whole. Some later and more successful work was done on the Island by Capt. F. D. Burdett, about 1912–1913.

Calayan Island was first explored by F. D. Burdett (in 1912–1913?), and several good burial-jars were obtained and later sold to the old Philippine Museum. In 1932 Aleko E. Lilius and I. B. Maddela excavated jar-burial cairns and mounds at Tumulod and Silpi, obtaining one burial-jar in nearly perfect condition, and several broken ones. As usual the bones were in a much-decayed condition. A few red carnelian beads, and

[1] Phil. Jour. Sci. § D 6 (1911) 1–5, pls. 5.

some pottery rings or ear-ornaments were found in one jar, but no metal objects of any sort. (There are probably still nearly a hundred unopened mounds on Calayan. Some of them should be excavated carefully.)

Babuyan Claro Island was visited in the late 1930s by several officers of the Coast and Geodetic Survey who reported the existence of numerous unexcavated jar-burials and several other interesting types of remains.

Dalupiri Island was first explored, rather briefly, in 1935, by Dr. H. H. Bartlett accompanied by José V. Santos and M. Kalaw, of the University of the Philippines Department of Botany. A few jar-burials in cairns were carefully explored—being located near the mouth and along the sides of the canyon called *Manolong.* One almost perfect burial-jar was obtained from a cairn; while in a burial niche facing the sea, another broken jar was found firmly wedged among the rocks. (These specimens are now in the University of Michigan Museum); in 1938 Doctor Bartlett published an excellent general review of "Jar Burials in the Babuyan Group * * * especially those of Dalupiri Island."[2] The bones had entirely decayed in all of the jars examined, although one tooth was found.

The Babuyan Group is still a treasure house of jar-burials of the early type—most of them definitely dating from the first half (if not the first quarter) of the Christian Era. (Full reasons for thus dating these jar-burials are given in my MS. paper entitled "Jar-burial in the Philippines," Manila, 1938—with supplement in 1941.)

Early Porcelain Age.—One of the graves excavated by Aleko E. Lilius on Calayan in 1932 contained a burial-jar of an entirely different type, and of somewhat later date. This is a medium-large but short and wide-mouthed jar with six ears, covered with a green glaze, and undoubtedly of Late Tang or Early Sung date—almost identical with some half dozen similar pieces found in the older section of the Hacienda Ramona Site, in Pampanga Province. In all cases these jars contained a considerable quantity of disintegrated bone fragments, and usually a few carnelian beads and other small objects (in one case a spindle whorl).

About 1923–1924 Mr. Frank D. Yost, of the Bureau of Lands, obtained a small and very well-made celadon dish, with a greyish green crackled glaze, from a homesteader on Calayan Island, who found it when excavating holes for his house-posts. The piece is undoubtedly of Sung date, and probably indicates an Early Porcelain-Age burial in that vicinity.

Several other celadon dishes and stoneware pieces have been reported from accidental excavations on Calayan and Fuga, but I have not yet examined any of them.

[2] Papers Mich. Acad. Sci. &c. 23 (1937) 1–20, 5 pls.

Later Porcelain Age.—F. D. Burdett reported finding a dragon-jar on Camiguin, and Mr. F. W. Sapp brought in several Early Ming fragments obtained in a cave along the coast of the same island. Doctor Bartlett found a few Early Ming blue-and-white fragments on Dalupiri; while J. Scott McCormick and some C. & G. S. officers found quantities of Early Ming sherds in the caves of Babuyan Claro. Those specimens that I have seen were probably all of 14th and 15th centuries, and were all Chinese wares.

At least two village midden sites of probable Early or Middle Ming date have been reported from Babuyan Claro.

Spanish period records.—Only on Babuyan Claro do any of the original Babuyan inhabitants survive. On the other islands they were induced to migrate to Luzon, between 1690 and 1750, by the early Dominican missionaries, and most of them appear to have settled in the Malaueg area of Cagayan Province. (A unique dialect is still spoken in that area.) The present population of the Babuyan Islands (except Babuyan Claro) is chiefly a mixture of recent Iloko and Ibanag settlers.

Workers.—Captain Mitchell, Merton L. Miller, H. G. Ferguson, F. D. Burdett, C. Willcox, Henry Becker, F. W. Sapp, Aleko E. Lilius, I. B. Maddela, J. Scott McCormick, H. H. Bartlett, and others. (For historical period: Otto Scheerer, Fr. Julian Malumbres, and H. H. Bartlett.)

B. LUZON AND ADJACENT SMALL ISLANDS

8. *Cagayan and Isabela Provinces (Cagayan Valley area):*

Mid-Pleistocene.—Fossil bed, containing rhinoceros teeth and bones, and probable remains of other large mammals, found by prospectors Alfonso Bagunu and Rodolfo Albano, in 1936, in the mountains just back of Laya, Cagayan (almost on the Cagayan-Isabela boundary line); and samples brought to their home in Cabagan, Isabela. (Later brought to Manila by Jose Datul.) This bed has not yet been properly explored.

Tektites.—A few true transported tektites found in October, 1945, by Lieut. William G. Beyer, in a field with reddish soil and containing manganese nodules, about 2 kilometers southeast of the Ilagan provincial hospital, Isabela Province. Five whole "Claveria-type" pseudotektites found on beach near Claveria, Cagayan, in 1928, and sent to Bureau of Science for determination.

Prehistoric shell-heaps.—Several large prehistoric shell-heaps were cut through, in road-building, near the Cagayan-Isabela boundary line. (Reported by Provincial Engineer before the war, but not yet properly investigated.)

Late Neolithic remains.—Three good Late Neolithic implements (two adzes and one chisel) were found by a Japanese officer in northern Isabela (exact locality not recorded) in 1942 (shown to me in Manila 1943, and drawings made). Two specimens are fully stepped, and one is plain-backed. (Taken by Mr.

Aikawa, of the educational department, Military Administration, in August, 1944, and probably lost or destroyed at end of war.)

Post-Stone-Age remains.—No record as yet of any Bronze-Age, Iron-Age, or pre-Spanish Porcelain-Age sites or finds, in these provinces. Undoubtedly some such remains exist—particularly of the Porcelain Age. For early history of the area, see Julian Malumbres "Historia de Cagayan," "Historia de Isabela," etc.

Workers.—(As mentioned under the preceding various items.)

9. *Apayao Subprovince (formerly under Cagayan; now under the Mountain Province):*

(No record as yet of any Stone-Age or other pre-Porcelain remains.)

Porcelain-Age survivals.—Ming jars, and possibly a few pre-Ming ceramic pieces, are still preserved among the well-to-do Apayaos as heirlooms. Also some ancient beads and silver ornaments. (It is said that such objects were formerly buried with the dead; but there has never been any proper archaeological exploration within the area.)

Spanish period remains.—The ruins of at least two old Spanish missions of the 17th century are known, but they have not been investigated.

Workers.—H. O. Beyer, MORICE Vanoverbergh, Otto Scheerer, and (for history especially) Julian Malumbres.

10. *Ilocos Norte Province:*

Pseudo-tektites.—No true tektites have yet been found in this province, but a large number of the so-called "Claveria-type" of pseudo-tektites have been found at the Selga Site, near Pasuquin. (Fr. Miguel Selga has written a paper on this material, published by the Philippine National Research Council in 1935–1936.)

Stone Age.—No genuine Stone-Age artifacts have yet been reported, except one small obsidian flaked microlith, sent to me by a local geologist, shortly before the outbreak of the war, with statement that he had found it in a field near Pasuquin. (The area should be further explored, as no other obsidian implement has yet been reliably reported north of Bulakan Province.)

Early Porcelain.—At least two Late Tang-Early Sung midden dumps or old village sites located by me on low elevations near Paoay Lake, during a brief trip in the fall of 1928. It is probable that other similar sites could be found near the coastal area.

Later Pre-Spanish Porcelain Age.—Late Sung, Yúan, and Early Ming celadons and other ceramic pieces have come from accidental excavations at various places in Ilocos Norte and Abra. Doctor Palencia, formerly attached to the mission hospital in Laoag, possesses an interesting collection of such specimens.

Spanish period remains and records.—Some very interesting old stone churches, ruined missions, "Moro" towers, and other

remains of the early Spanish period exist in this province. (Photographic and descriptive records should be made for permanent preservation.)

Workers.—Miguel Selga, H. O. Beyer; and (for history especially) Isabelo de los Reyes, and Camilo Millan.

11. *Abra Province:*

(Some interesting fossils and shell-beds, near Kimalásag barrio, Pilar municipality, have been reported as early as 1926 by Jose V. Corrales; but have never been properly explored or verified.)

Late Neolithic artifacts.—Several good adzes and chisels (at least two of which are early "stepped" forms) were located by Dr. Fred Eggan in 1934–1935. A few were accidental finds, preserved in the charm-boxes of Tinggian medicine-men as magic stones. (No actual Neolithic site was located.)

Other Late Stone-Age remains.—A number of sandstone knives, daggers, and arrow-points or spearheads, of a peculiar type associated with a crude hand-made pottery, were found by Jose V. Corrales from 1926 to 1928, in the Pilar Sites near the Ilocos Sur boundary line.

Mixed Late Iron-Age and Early Porcelain-Age area.—The "Corrales Sites" in Kimalásag barrio, Pilar—explored chiefly in 1926–1927—contain what appears to be a Late Iron-Age and a Sung-period Porcelain-Age mixed culture. Both burial sites and midden deposits were found, and some very interesting specimens obtained.

Later Porcelain Age.—Numerous heirloom jars and other ceramic pieces, specimens of ancient beads, and other objects are preserved in the homes of the wealthier Tinggians in many parts of the province. A number of good burial-pieces have also turned up in accidental excavations, and several private collectors in Bangued had accumulated a number of them before the war. (The best of these collections, in Bangued, Vigan, and Laoag, were examined and described by E. D. Hester, in March–April, 1933.) Much data on the rare beads was recorded by Dr. F. C. Cole.

Surviving early records, etc.—Much interesting data on pre-Spanish conditions survives in epic poetry, both in Iloko and in Tinggian (Itneg). Some of these epics have been discussed by myself and Isabelo de los Reyes, F. Blumentritt, Juan T. Burgos, Dr. F. C. Cole, and Ernestina L. Llanes.

Workers.—(As mentioned under the preceding various items.)

12. *Kalinga Subprovince (now under Mountain Province):*

(No true Stone-Age artifacts yet recovered.)

Bronze- and Iron-Age survivals.—Certain ancient metal ornaments, gongs, and rare beads, still possessed as heirlooms by the wealthier Kalingas, may be Bronze- or Early Iron-Age productions. Certain bead types especially, that are very highly valued by the Kalingas, seem to be definitely of Greek or Roman

manufacture sometime prior to the beginning of the Christian Era. Exactly similar beads have been found in Rizal Province in sites of the 2nd century B. C., and one type, at least, is still earlier than this (pre-Iron Age) in Batangas Province.

Pre-Spanish Porcelain-Age survivals.—The Kalingas, like the Apayaos and Tinggians, are great collectors of ancient porcelains and jars. A majority are of Early Ming dates or later; nevertheless, a number of good pieces of Yúan and even Late Sung dates are still to be found. They are not easily obtained, however, as the value that the Kalingas place upon such pieces is often as high, or even higher, than their worth to a foreign collector.

A number of good celadons have come from northern Kalinga; and, rather surprisingly, several of the best specimens that I have seen are of Sawankhalok manufacture. Early and Middle Ming blue-and-whites and polychrome wares have also been found. It is still uncertain as to how many of these pieces are true heirlooms—and I believe that a number of them, at least, have actually come from accidental excavations.

Monumental and other remains.—The origin of the great stone-walled rice terraces, and certain other remains of a monumental character, will be taken up later in connection with Ifugao and Benguet Subprovinces.

Workers.—H. O. Beyer, R. F. Barton, W. S. Boston; and (for linguistics and history) Otto Scheerer.

13. *Bontok, Lepanto, and Amburayan Subprovinces (old boundaries, as of 1912. Then wholly under Mountain Province; now partly joined to Ilocos Sur, etc.):*

(No true Stone-Age original artifacts yet found; but much use of stone tools in later cultures—some of them doubtless being carryovers from Stone-Age times.)

Bronze-Age and Iron-Age remains and survivals.—A true Copper-Bronze culture, centering in Lepanto Subprovince, is probably also to be associated with the early stone-walled rice terraces and other special features of the Terrace Culture in general. Remains of ancient copper, silver, and gold mining, smelting, and working have been found in various places. Also certain ancient ornaments and beads, as well as a few old gongs, images and copper or bronze vessels, that probably go back before the beginning of the Christian Era, although many others of later periods, are still in use.

Porcelain-Age remains and survivals.—Ancient jars, beads, and the like are scarce among the Bontoks, but more plentiful among the Igorots of outlying areas. However, a few Ming pieces are found nearly everywhere, but only in the Bakun highlands of Amburayan are the older pieces really common.

The only pre-Spanish midden sites yet found are located on the low tableland on which the town of Cervantes now stands, both to the north and the south of the town. The specimens examined seem to be mostly Early Ming sherds, with a little

later material mixed in. A few old fragments were also picked up by me at one spot near the town of Baúko—but time was not available for a careful examination of the area.

The most interesting Igorot remains occur in the region around the Sagada Plâteau, where the abundant limestone caves, niches, and rock-shelters have long been used as burial places. Numerous fragments of decayed wooden coffins, skulls and other bones, and occasionally sizable ceramic fragments are common in rock-shelters under the edges of the cliffs. (None of these have ever been properly excavated; and a careful survey should be made there, if opportunity offers.)

This whole area presents a rich field for future archaeological work. Doubtless many old village sites and burial places could be located by a little patient research, in all three subprovinces, and their careful investigation might well throw much new light on the whole past history of the region.

Workers.—A. E. Jenks, James A. Robertson, H. O. Beyer, R. F. Barton, Morice Vanoverbergh, Angel Perez, M. Goodman, A. J. Eveland, and W. F. Hale.

14. *Ilocos Sur and La Union Provinces:*

Stone-Age remains.—A true Late Neolithic stone adze or chisel, of regular trapezoidal form, was found near San Juan, La Union in the 1920s, by Forester Dacanay. (The exact site has not been recorded.)

(The stone daggers, mentioned under the next item below, from Santa, Ilocos Sur, may also possibly be of Late Neolithic date.)

Early Porcelain-Age remains.—At Santa, Ilocos Sur, near the Abra River Gap, several graves were cut into during road-building, containing early Sung funerary pottery and porcelanous wares (exactly similar, in type, to those illustrated and described by B. Laufer, as coming from Early Sung graves in north-central China). On a nearby hill, another still older grave was cut into, containing no imported wares, but only two pieces of hand-made native pottery associated with two stone daggers of the peculiar sandstone type described under Abra Province.

Epic poetry and early traditions.—In northern La Union, and elsewhere, several ancient epic poems (dating probably from the late pre-Spanish and early Spanish periods) have been preserved. Some of them describe wars with the "Tattooed Igorots," and give many interesting details of pre-Spanish Iloko life and beliefs. The best known of this group of epics and traditions is *Biag ni Lam-ang,* recorded at an early date by a priest of Bangar, La Union, and first printed in 1889; but there are other poems also of much interest. (A serious comparative study of this early literature should be undertaken.)

Workers.—Gerardo Blanco, Isabelo de los Reyes, José V. Corrales, Juan T. Burgos, Emerson B. Christie, Morice Vanoverbergh, Leopoldo Y. Yabes, Jose R. Calip, and Ernestina L. Llanes. (Also see Addendum for further data on La Union Province.)

15. *Benguet Subprovince (now under the Mountain Province):*

Stone-Age remains.—A Late Neolithic stone adze or chisel, with a slightly curved back and of a rather rough trapezoidal form, was found in a hillside clearing near Haight's Place (K. 53, Mt. trail). Igorot tradition reports similar specimens being occasionally found around Kabayan, and in the Agno and Kapangan River Valleys where they are known as "thunder teeth," and are regarded as possessing potent magic properties.

Terrace culture.—The stone-walled rice terraces of the Kaiyapa District are probably the most ancient in the Mountain Province—and have been the subject of a special study by myself. (Many areas there have been long abandoned, and both ancient village-sites and walled-up tombs in the mountain sides should be sought for and excavated.)

A long-abandoned village site, with a nearby walled-up tomb of good size, exists on top of the high ridge above the Itogon Mine—first called to my attention in 1937 by J. H. Marsman. I made a careful examination of the area, and regard it as well worthy of study and excavation, but work there will be difficult owing to the nature of the terrain. (The age may be anywhere from a few generations past up to several centuries, but it is no longer remembered in local tradition.)

Early Metal-Age remains.—Certain ancient copper and gold workings, in the Itogon-Búa area especially, go far back into the past and seem to show a kinship to the old Lepanto workings (described under item No. 13, above). Some very ancient gold ornaments, copper vessels, sacred drums, gongs, and the like, still existed among the wealthier Igorots before the war.

Porcelain-Age site and survivals.—A grave containing whole pieces of late 15th and early 16th century Ming porcelains was cut into during development work on the Gold Creek Mining Co. property near Búa in November, 1932 (found by the late C. L. O'Dowd); while other graves with similar contents are reported to have been destroyed in former times in the same vicinity.

Many old jars and other ceramic pieces are also kept by the wealthier Igorots, especially in northern and eastern Benguet.

Burial caves and mummies.—One of the most interesting types of remains in this Subprovince, however, is the great number of burial caves and niches, containing wooden coffins, bones, and especially (in some places) dried mummies. These mummies have remarkable lasting qualities, considering the climate; and the history of several specimens, at least, has been traced back to from 150 to over 200 years. (The preservative used is the *sablut* concoction, also known to the ancient Ilokos and to the Ifugaos.) One cave on Mt. Sto. Tomas, near Baguio, was found to contain more than 20 mummies, of which at least half were in a fair state of preservation. Near Buguias and Loo, in the northern part of the Subprovince, the famous mummy of Anó—long kept in a burial niche in a nearby cliff, treated with re-

spect, and made frequent offerings by the people—was stolen by a missionary from San Fernando, La Union, and later became the object of a court case. The specimen, having been placed in my charge for some time, was examined by me carefully and its history investigated. It proved to be over 200 years old, and was still in perfect condition, having been kept in a wooden coffin in a dry niche, at an elevation of nearly 7,000 feet above sea level. The body was completely tattooed, from the top of the forehead to the soles of the feet, with an intricate pattern of the type illustrated by Hans Meyer in his monograph on the Igorots in 1885. (All mummies still existing should be scientifically studied and photographed.)

Workers.—Hans Meyer, Angel Perez, Otto Scheerer, H. O. Beyer, Alphonse Claerhoudt, and others. (See Addendum for further data on Benguet.)

16. *Ifugao Subprovince (now under the Mountain Province):*

Stone-Age remains.—A well-made Late Neolithic stone adze, of a trapezoidal early stepped form, was found by Colonel Munson and Doctor Pick in a newly excavated road-bank between Kurug and Piwong, in central Ifugao. Several years later I examined the area briefly, finding no more stone implements, but locating in a similar road-bank nearby a vein of much disintegrated pottery fragments. These small sherds had exactly the appearance of the Early Iron-Age wares of Rizal Province. (The area should be thoroughly examined at the first opportunity.)

Stone-Age survivals.—In addition to the rice-terraces there are many other modern uses of stone in Ifugao life,—some of which seem to be direct survivals of a Neolithic culture. Until recently Ifugao smiths did all their finest metal work with stone hammers and stone anvils, in addition to the usual three-stone set-up of their forges and fireplaces. Sharpening stones, polishing stones, small mortars and pestles, mullers, stone beads, and a variety of other objects; throwing-stones, as weapons; etc., all testify to such survivals.

Stone implements, tektites, and fossil mammalian teeth (particularly of the timarao and wild carabao) have all been reported as being found among the "Buga" or magic stones, in Ifugao sacred "medicine-boxes." (I have collected some of the fossil teeth, but have so far failed to secure any authentic specimens of the tektites or stone implements.)

Terrace culture.—The great system of Ifugao rice-terraces—most spectacular of its type in the world—is now believed to have had its beginning in the Copper-Bronze period, several centuries B. C. The Hungduan-Ahin Valley, which is the greatest single terraced area, and the Hapao Valley adjoining, both contain remnants of important secondary copper-bronze industries—although the copper, gold, and silver themselves mostly came from the Lepanto area previously discussed. Ancient copper pots, spoons, images, and ornaments were formerly very com-

mon in these valleys, but have now largely disappeared. Copper silver bronze gongs, and bronze-silver-gold ornaments were still quite common prior to the recent war.

Ancient beads, jars, and gongs.—The oldest Ifugao bead types are probably Greek and Roman specimens dating from the 5th to 1st century B. C., but the commonest of the rare types is a special Bactrian bead, known as *Pañgo,* consisting of two amber-glass cylinders with a layer of gold-leaf between, probably also dating from before the beginning of the Christian Era. (Pañgo beads are also found in the Batanes Islands, and among the Tinggians of Abra and western Kalinga.)

Old jars and bronze gongs, mostly of Chinese origin, are possessed by wealthy families and some pieces have been handed down as heirlooms for a dozen generations or more. Ming jars are still fairly common, but pre-Ming pieces are very scarce—those that I have seen being probably all of Late Sung or Yúan dates.

Literary antiquities.—Ifugao epic poems and myths (especially the *Hudhud* and the *Alim*) are worthy of extended study for the light that they may throw on the past, as well as for their literary character itself. (They should be studied especially in comparison with similar epic and myth material from adjoining Igorot regions in Lepanto and Benguet Subprovinces; etc.)

Workers.—Juan F. Villaverde, Julian Malumbres, B. Campa, Angel Perez, Dean C. Worcester, H. O. Beyer, R. F. Barton, Jeff D. Gallman, and Francis Lambrecht.

17. *Nueva Vizcaya Province:*

(No true Stone-Age material yet recovered. Although potentially interesting and possessing a long historical record, this province has been but little explored archaeologically, and few pre-Spanish remains of any sort have been found.)

Possible Iron-Age site.—Some possible Late Iron-Age decorated pottery of a very interesting type was found by the late Tom Myers on an ancient village site in the heart of the Ilongot country, in May–June, 1935. On the Conwap River, several hours to the west of Pugu (in the Abaká country), an interesting site was found on the crest of a ridge or hill above the stream. The chief content of the midden site was a quantity of peculiarly decorated pottery, with incised designs of a unique pattern not yet found in any other Philippine area. A liberal sample was brought in for my collection, but much more could be gathered there. No porcelain fragments were found in the midden area, and it seems very possible that the site may be pre-Porcelain Age.

Ruined Spanish Missions.—Interesting 17th and 18th century Spanish-period objects have been found around the ruins of the early Augustinian missions in the Ilongot country—all of which were closed down and completely abandoned about 200 years ago. The ruins of at least eight or ten stone churches are known.

but only a few have been visited or described. Myers found two that had not been previously reported. Seventeenth and eighteenth century ceramic fragments were plentiful around both of them. (Mostly Chinese porcelains and stoneware, native wares being rather scarce.)

Workers.—Francisco Gainza, B. Campa, Julian Malumbres, W. C. Bryant, Wilfrid Turnbull, Carl Taylor, H. O. Beyer, Tom Myers, and Antonio Mozo.

18. *Nueva Ecija and northern Tayabas (old "Principe") Provinces: (These two areas are combined for geographical reasons, but will be discussed separately: (a) The old Spanish province of Principe, now a part of Tayabas [Quezon] Province; and (b) Nueva Ecija Province proper (which formerly included all of northern Tayabas):*

(*a*) *Northern Tayabas.*—(No true Stone-Age remains yet found and only one pre-Spanish site of any considerable importance. However, other pre-Spanish remains should be sought, especially at Baler and Kasiguran, around Dingalan Bay, and on the Island of Polillo.) [See Addendum for further data on Polillo Island.]

Lampong Bay area.—One pre-Spanish porcelain-bearing site of Ming date was found by W. S. Boston near the port area at Lampong Bay, in the early 1930s. (This area should be carefully explored, as it was an important landing place not only for Chinese traders but also for the Spanish galleons, at certain seasons.)

Workers.—Alexander Schadenberg, Wilfrid Turnbull, W. S. Boston, and others.

(*b*) *Nueva Ecija Province.*—(Stone-Age or other pre-Spanish sites have not yet been located; but a natural tektite site and some interesting Spanish period remains are worthy of mention):

Tektites.—Some two dozen true natural tektites were found about 1928, by E. K. Harper, in the area around and a little to the east of Balete Pass, on the Nueva Vizcaya border. Most of these specimens are now in the American Museum of Natural History (New York). They are not plentiful, but Harper is of the opinion that many more could be found there by diligent search.

A few transported tektites were found in 1938 in a gravel heap at Muñoz (said to have been brought from a river bed a few kilometers away). The original find was made by the late Fidel Mayson, but was not followed up and no further specimens have come from that area.

Porcelain-Age and Spanish period remains.—A few old and probably pre-Spanish porcelain fragments were found by myself and Mr. E. D. Hester in 1938 on a hill above Laur,—probably part of an old village midden. The grass-covered terrain and lack of time prevented any proper exploration.

Some interesting 17th and 18th entury jars and other ceramic pieces have come from around San Leonardo, doubtless being

all or mostly heirloom pieces. No specific burial pieces have been reported.

(Source of old Tinggian villages near Cuyapo, and their history, should be sought. Also, the 17th and 18th century mission sites at Puncan, Caranglan, and Pantabañgan should be further explored.)

Workers.—(As mentioned under the foregoing various items.) Also Luther Parker, Percy A. Hill, David P. Barrows, Epifanio de los Santos, and Dr. J. P. Bantug.

19. *Tarlak Province:*

(No Stone-Age or other prehistoric sites have yet been reliably reported from this province.)

Porcelain-Age finds.—A few scattered ceramic pieces and some jars of Yúan, Ming, or later dates have been reported as accidental finds or as inherited heirlooms; but no actual site has been recorded or explored.

Workers.—None. (See Addendum for data on caves, etc.)

20. *Pangasinan Province:*

Tektites and Pleistocene fossils.—Two interesting natural tektite areas have been located, one along the Zambales-Pangasinan border, and the other in the Bolinao area. The latter area produced the largest specimen (620 grams) yet known from the Philippines north of the Bikol area; also some unusually interesting large tektite disks. They were found by F. W. McCaw and J. Kershner, in the early 1930s. (For the border site, see Zambales Province.)

A completely fossilized elephant tooth of a probably unique dwarf species (but possibly merely a baby form of a larger species) was found before 1920 on Cabarruyan Island in Lingayen Gulf, near Alaminos. (It has been identified as an extinct form, and, a possible new species, of probably Late Pleistocene date, by Dr. G. H. R. von Koenigswald.)

Stone-Age remains.—A few used stone hammers and grip-marked stones of uncertain prehistoric dates (one being a large tektite) have been found in the Bolinao area.

Early Porcelain-Age site.—A very interesting ancient burial site was discovered by Mariano Dizon in 1928 near the town of Balincaguin, in the hilly region of the western part of the province. The site is in a recently cultivated area near a small spring, several kilometers from the present town.

The first find was a burial-jar, the top of which was accidentally struck by the plow. This was dug out, but found to contain only part of a skull and some bone fragments. Further excavation in the vicinity turned up many other burial-jars, together with a considerable number of smaller pieces of porcelain, stoneware, and pottery. It is also claimed that one of the jars contained several old coins, all having a square hole in the center and bearing Chinese characters. A dozen of the smaller whole pieces, and one of the coins, were later turned over by Dizon to H. P. Whitmarsh, of Baguio, who

subsequently took them to England where I believe they still are. Before leaving, Mr. Whitmarsh brought these pieces to me in Manila for examination. They all seem to be definitely Late Tang and Early Sung productions, somewhere between the 9th and 12th centuries.

In 1929 this site was visited by Victoriano Braganza, who later wrote an article about it.[3] He obtained a few more pieces, including a very early type of dragon-jar similar to those from the Hacienda Ramona Site in Pampanga Province. He also located a village midden site, on a neighboring hill, containing quantities of fragments of various Chinese wares. Everything that he describes or illustrates seems to be pre-Ming, and his interpretation of the site is entirely wrong.

This whole area should be carefully investigated when opportunity offers.

Later Porcelain-Age remains.—Two other pre-Spanish porcelain sites were found between Lingayen and Bolinao, in a canal that was being dug. One of them contained a unique Chinese jar of probable Late Sung or Yúan date, bearing an embossed European head similar to the designs on Roman coins. This specimen, and other early jars from both sites, were brought to me by the late Major Eugene de Mitkiewicz in April, 1929. A few other accidentally excavated pieces have been reported, but, so far, no Sawankhalok or other imported Southeast Asia wares are known from Pangasinan Province.

Another find that should have been mentioned above is that of a coin of the third century B. C., bearing a Greek design but probably of Celto-Iberian origin, which was found while doing road-work between Pozorrubio and Camp One, in the northeastern part of the province. This coin, of which an illustration has been published, was formerly in the collection of Dr. J. P. Bantug, and lost during the war. (An exactly similar coin was found in a garden at San Pedro Makati; see Rizal Province.)

Other protohistoric survivals.—Pangasinan offers rich archaeological possibilities for further exploration. The name Lingayen ("place of the *lingga*") suggests the former presence of a Hindu-Malayan community with phallic monuments, and elements in the traditional history and surviving myths support such possibility. The province has been the entry point for several of our ancient and more interesting cultures, and it seems very probable that remains of their former presence or passage here can still be found.

Workers.—Justo Claudio, Eusebio Rosario, Paz R. Reyes, Ricardo Sison, Carlos P. Romulo, H. O. Beyer, Leslie F. Taylor; and names mentioned under the foregoing various items.

21. *Zambales Province (present boundaries only; old northern Zambales being now a part of western Pangasinan, q., v.):*

Tektites.—Found in large number along the present Pangasinan-Zambales border. Also on two chromite mining prop-

[3] Philippines Free Press, August 3, 1929.

erties, in the foothills a little south of the border. What appears to be another natural site lies in the hills back of San Marcelino, near some copper mining claims formerly operated by Aguado Hermanos. (The Zambales tektites are all good natural specimens, with unusual form-characteristics that give them special interest. Plate 2, fig. 2.)

(No true Stone- or Iron-Age remains yet reported.)

Porcelain-Age remains and survivals.—One interesting midden site of Yúan and Early Ming date has recently been located by Robert B. Fox and Governor Francisco Anonas (June, 1947), on a small hill at the sitio of Purakin, near Ugik, on the old Cushman Ranch (now belonging to the Governor). Another similar site exists at Alibaiyan, near Ugik, but no fragments from this area were brought in. (Fox expects to explore the area more fully, soon; it lies only about three kilometers from the Villar Farm School.)

A few scattered ceramic pieces—all of Late Sung, Yúan, or Early Ming dates—have been reported as accidental finds, in several other Zambales areas (particularly near Botolan), but no definite burial site has yet been located or explored.

A few ancient beads have been occasionally found among the Zambales Negritos, and some were collected in 1913 by J. M. Garvan. Tradition speaks of stone arrow-points also being used among the Negritos in pre-Spanish times, but no trace of such material has yet been found.

Workers.—A. B. Meyer, W. A. Reed, Francisco Cañamaque, Fr. Domingo Perez (1680), J. M. Garvan, Paul Schebesta, Robert B. Fox; and (for tektites) Otto Frauendorf, Wilfrid Turnbull, Churchill Scott, and Herminia Gaerlan de Hernandez (for Babuyan Site).

22. *Bataan Province:*

Stone Age.—On the China Sea side of Bataan Province, particularly on certain sloping tablelands used for grazing, considerable numbers of protoneoliths of Bacsonian type (varying from crude to quite well-made specimens) have been found scattered over the present surface. Several collectors have gathered specimens, but no systematic exploration has been carried out. Four rather similar specimens were picked up by Leonardo Vasquez, in February, 1929, on a low ridge near the Lamao Agricultural Station, but no other stone implements, of either pre-Neolithic or true Neolithic types, have been recorded from Bataan Province.

Porcelain-Age remains.—A number of accidental finds of ceramic pieces, mostly of Late Sung or Ming date, have been made in this province; but no actual ceramic site has been located or properly excavated there. Some interesting early fragments have been picked up along the Manila Bay shore, particularly between Samal and Orani in the northeastern part of the province. (also see next item.)

Gold coins of the pre-Spanish period.—Several small button-shaped gold coins, usually bearing the embossed character "ma" in

the old syllabary, of types current in Java and Indo-China during the Hindu period, have been accidentally excavated in Bataan. Dr. J. P. Bantug has described a find of 70 such pieces, made in October, 1914, in the barrio of Tiis, Bagak municipality, and he had in his possession one of the specimens at the beginning of the war. This was a hoard, buried in an old clay pot which was accidentally plowed up and broken by a farmer named Alberto Ledesma. (These coins are exactly similar to another hoard buried in a pottery vessel near San Felipe Neri, Rizal Province, discovered in 1887 and described by Isabelo de los Reyes and Dr. A. B. Meyer. See later reference under Rizal Province.)

(All of the coastal area and nearby foothills in Bataan should be carefully explored, especially while the post-war reconstruction is going on. The Mariveles area should not be overlooked, despite the great wartime destruction there, as it was probably here that the first Chinese and foreign trade-centers were located.)

Workers.—A. B. Meyer, W. A. Reed, J. M. Garvan, E. B. Rodriguez, Major Albert J. Brazee, Dr. José P. Bantug, and Robert B. Fox.

23. *Pampanga Province:*

(No pre-Neolithic artifacts, and no fossils or tektites, yet recovered in this province.)

Neolithic remains.—A good specimen of a slightly trapezoidal Late-Neolithic chisel, and two other probable Neolithic artifacts of a cruder type, were found in plowed fields near the Hacienda Ramona ceramic site, but were probably in no way connected with that site itself. (A number of interesting used hammers, mullers, grip-marked stones, etc., were found in the ceramic site, but most of these are undoubtedly Porcelain-Age survivals from the Neolithic.)

Porcelain-Age remains and survivals.—The remarkable site at the Hacienda Ramona will first be taken up, after which several other miscellaneous finds, etc., will be treated separately:

Hacienda Ramona Site.—On this plantation, near Porak, there exists a remarkable and extensive Porcelain-Age site of an early type, known as the "Goodall Site," and first explored in 1935–1936 by G. M. Goodall and two Filipino assistants, working under my general direction. (The resulting collections are mostly in Manila.)

A more extensive exploration was carried out in 1939 by E. D. Hester, George Woods, and Herman Costenoble, assisted by Manager Suarez and certain other officials of Warner, Barnes & Co., who own the Hacienda. A large quantity of burial-jars, and of smaller ceramic pieces of various shapes and sizes, was obtained—most of which I saw or examined briefly from time to time. (A part of these specimens were sent to the United States, but the

great majority were, unfortunately, disseminated or definitely destroyed during the war.)

The site is large and at least three periods of inhabitation are identifiable:

1. An extensive burial area dating from Late Tang to Middle Sung (mostly with plain glazed burial-jars, exactly like the one from Calayan Island, mentioned under item No. 7, above.)
2. A village site and less extensive burial area, dating chiefly Late Sung and Yúan (with early dragon-jars, and similar objects).
3. A small village site, and possibly a few graves, dating from the beginning of the Ming period; located a short distance up the slope from the major site.

It also seems probable, from reports of plantation workmen and local natives, that several other as yet unworked burial sites exist in this vicinity.

In addition to the three types of burial-jars and associated wares the Hacienda Ramona Site presents certain features of special interest for ceramic study and interpretation—a few of which are: (*a*) The presence of large quantities of Yüchow and other southern Sung wares. (*b*) Several good examples of the rare *tobi-seiji*, or spotted celadon, associated with Ying Ch'ing fragments—one whole piece being in the form of an unusually well-made carabao (the glaze between the spots being a delicate translucent blue-green that is typically Ying Ch'ing). (*c*) The fact that no whole pieces and only two early fragments of blue-and-white ware have been found in the entire site (and these may be Yúan rather than Early Ming). (*d*) No identifiable Sawankhalok or other southeast Asia wares have yet been found, although some probable Tang black-glazed and apple-green glazed pieces and fragments closely resemble the Kalong wares of northern Siam. (*e*) Several uniquely fluted small teapots and wine-pots, of types rather unusual in Philippine sites, are worthy of special study.

The Hacienda Ramona Site is still far from exhausted, although many good ceramic pieces have been crushed and scattered by the use of heavy tractors and mechanical plows and cultivators on the plantation. Much of the exploration work in the past has been far from scientifically conducted—and, in the future, some small undisturbed areas should be fenced off and excavated systematically. The results might well settle some important points concerning the history of the site that are still vague or definitely doubtful.

Other Porcelain-Age sites.—The late Herman Costenoble, in 1940–1941 found two other Early Porcelain-Age sites on a sugar plantation some distance to the southeast of the Hacienda Ramona. (Shortly before he was killed during the war, he fur-

nished me with a map and some notes on these sites, as well as a number of midden fragments found in the vicinity. However, there was no opportunity for further exploration.)

Dr. José P. Bantug formerly possessed several very interesting ceramic pieces from Pampanga sites. One of these—accidentally excavated in the vicinity of Lubao while a well was being dug—was a medium-large Tzechow type of black-and-white decorated jar or vase, of a type heretofore known only from Site B in Rizal Province. He also had other pieces, both Sung and Ming, excavated in the Lubao area, as well as one or two from other localities.

On the whole, Pampanga, together with neighboring parts of Bulakan and Bataan, offers the best field for our next systematic exploration, and the work should not be too long delayed.

Workers.—(As indicated under the preceding various items.) Also Ricardo E. Galang, Sol H. Gwekoh, Cornelio Pabalan Byron, Luther Parker, W. Huse Chapman, H. O. Beyer, and Leslie F. Taylor.

24. *Bulakan Province:*

(Like Rizal Province, Bulakan probably contains practically all of our known archaeological horizons; but, so far, we have systematically explored only a relatively narrow strip along the Rizal-Bulakan boundary line. Our systematic explorations have been chiefly in the Marilao River Valley and along the Novaliches–Ipo Road, and throughout the rest of the province we have made only the usual type of casual or accidental finds. As the Marilao and Ipo Road finds have all been included in the regular "Rizal-Bulakan Collection," they will be discussed under No. 25 below, and, for the present, we will confine ourselves chiefly to the other Bulakan Province finds that are not included in that systematic collection.)

Tektites: (1) *The Pugad Babuy collection.*—The old Tagalog barrio of Pugad-Babuy (now known officially as "Torres Bugallon"), a part of Polo municipality, contains what is probably the world's largest concentration of natural tektites—certainly much the largest deposit yet discovered. More than 50,000 good specimens have been taken out of this site for my own collection, and probably around 10,000 more by other collectors. And there are still many more to be had in the area. In addition to the Pugad-Babuy Site proper, the Maysan and Karawatan areas are also included in the main collection.

(2) *Other Bulakan tektite areas.*—No other extensive natural tektite deposits have yet been found outside the Pugad-Babuy, Karawatan, and Maysan areas—although they may exist—but several secondary or transported deposits have been found. At two points along the road from Maysan to Novaliches, a few specimens have been found. Also, at three points in Meycauayan municipality Miss Natividad P. Noriega found a few specimens in old rice-fields—all showing signs of transport, or use as charmstones. No systematic search for tektites has yet been made in other parts of the province.

Pre-Neolithic stone artifacts.—In addition to tektites, portions of the Pugad-Babuy and Maysan areas contain a sizable quantity of Mesolithic obsidian and flint microliths, and a few undoubted palaeoliths have also been found in plowed fields within the tektite-bearing area.

A number of true palaeoliths found in the Marilao Valley will be included in the Rizal Province discussion, as also will be several small Mesolithic sites in the same area.

A few scattered specimens have been picked up elsewhere in the Province—mostly as surface finds—but none worthy of special discussion.

Neolithic artifacts.—All so far found (considerable numbers in some cases) have been within the systematic area—and will be discussed with the Rizal material—except the Ginyug Site, see No. 4 below.

Metal Ages.—One of our best combined Late Neolithic and Bronze-Age sites, and our third largest Early Iron-Age site, both lie directly on the Bulakan-Rizal boundary at Site H. No other pre-Porcelain sites have been found so far, outside the area of systematic exploration.

However, the largest Central Luzon iron-ore deposit yet known lies in the Angat-Norzagaray area, and it has been more or less continuously worked in a desultory way since early Spanish times. It seems quite probable that a pre-Spanish iron working may have existed in the area, but it has never been properly explored with a view to locating the remains of such an industry, and such a search should certainly be carried out at an early date.

Pre-Spanish Porcelain-Age sites.—The following pre-Spanish ceramic sites have been located (but very casually explored) in parts of Bulakan Province outside the area of systematic exploration:

(1) Dalawán barrio, San José municipality; 15th and 16th century porcelain and jar fragments, found by "Ario" de la Cruz in 1928.

(2) In June, 1929, W. S. Boston found seven 15th century ceramic fragments on a small hill at the site known as "Boston's New Mine," on the upper Santa Maria River, a short distance to the east of Ipo.

(3) In 1931 seven whole or nearly whole ceramic pieces, three certainly of Sung date and four others dating from the 14th to the early 16th century, were obtained from homesteaders who had accidentally excavated them on their lands in the area above the Ipo dam and around the headwaters of the Santa Maria River about 7 to 8 kilometers east of Ipo. (Collected by Feliciano and Islao directly from the homesteaders.)

(4) In June, 1934, a very remarkable site (but one quite difficult to get to) was found by a farmer named Isabelo Ramos at a place called Kinyug or Ginyug, on land owned by a certain "Doctor Araneta" about 6 kilometers east of the Novaliches–Ipo Road at Km. 35?

(Said to lie on Tialok Creek, about 5 kilometers above its junction with the Santa Maria River; and to be 3 hours walk from Site H, in a generally east or southeasterly direction.)

This Ginyug Site consists of at least two distinctive horizons: (1) an area of about one square kilometer containing only Early to Middle Neolithic stone artifacts; and (2) a strip along one side of the area—and comprising several plowed fields and a small hill or ridge—containing numerous common pottery fragments mixed with sherds of Late Sung, Yúan, and possibly Early Ming date.

The Neolithic area contains Luzon adzes (at least three were found) of Middle Neolithic type, associated with Early Neolithic adzes of more or less typical form, and some other interesting artifacts.

On the whole this site seems to demand further exploration at the earliset practicable date.

Decorated Manila-ware jars, and the like.—Five of our finest specimens of large decorated "Manila-ware" water-jars—of 16th, 17th, 18th century—have come from Bulakan barrios, where they have been preserved as heirloom pieces. Found chiefly in San José, Meycauayan, Polo, and one from Pugad-Babuy barrio. One plain Manila-ware jar also came from Bocaue. (All were manufactured at San Pedro Makati; see Rizal Province.)

Workers.—(As indicated above.) Also H. O. Beyer, W. S. Boston, J. P. Bantug, Fidel Mayson; and (for tektites) F. W. McCaw, Miguel Selga, Ralph Busick, E. D. Hester. [For further Bulakan data, see Addendum.]

25. *Rizal Province (including results of the Rizal-Bulakan Archæological Survey):*

Early period.—Prior to the year 1926, the chief finds made in Rizal Province and the Manila area had been as follows:

(1) In 1887 a small stoneware jar was excavated in San Felipe Neri, filled with small button-shaped gold coins—each embossed with the character "ma" in the old syllabary—of a type common during the Hindu period. Most of them were melted up or disseminated, but Isabelo de los Reyes obtained a few, one of which he gave to Dr. A. B. Meyer, who deposited an accurate cast of it in the Batavia Museum, where it probably still is.

(2) Around 1901 Felipe G. Calderon and Dr. David P. Barrows excavated two or more Sung-period graves in Santa Ana (see later Beyer-Boston notes on same site), and obtained some fine celadon and Ting-yao pieces—some of which were sent to the United States by Doctor Barrows and by Dr. Wm. Musgrave of the Philippine General Hospital.

(3) In 1908 a small Sung-type stoneware jar and a small celadon dish were found at a depth of about 4 feet in the bank of the Marikina River at the town of Montalban, by a woman washing clothes—the bank having recently partially caved down due to a storm.

(4) Early in 1920 four very interesting Late Neolithic stone adzes were found by employees of Aguado Hermanos—one from the hill at the top of a stone quarry at Binangonan, and three nephrite specimens while dredging gravel from the bottom of the Pasig (just in front of the Provincial Building at Pasig).

(5) In 1920 Contractor Charles G. Wing found two fossil bovine teeth (carabao) in a deep excavation in San Juan; while another fossil tooth found while boring an artesian well through the *tufa* in the same vicinity proved to be that of a prehistoric deer.

(6) An extensive hoard of 16th and 17th century silver coins, of early Spanish types used in the West Indies, Mexico, and the Philippines, was dredged up in the Marikina River (1914–1915), at a point a little below where the present bridge stands.

(7) In 1922 a very interesting Celto-Iberian coin of the 3d century B. C., bearing a well-preserved Greek design, was dug up in a garden near the Pasig River at San Pedro Makati. (The importance of this coin was greatly enhanced by the finding of another exactly similar specimen in Pangasinan Province, q. v.)

(8) About 1919–1923 Mrs. Robert M. McCrory and Hazel Clark Taylor assembled a remarkable collection of old Manila gold work (both pre-Spanish and early Spanish, in origin), including especially bead necklaces, earrings, finger-rings, brooches, hair-ornaments, and the like (it is to be feared that this collection was partly disseminated and the remainder destroyed during the war).

Period of systematic exploration (1926–1930).—(Stimulated by the discoveries at the Novaliches Dam, in February 1926, a period of active exploration was begun—later known as the Rizal-Bulakan Archaeological Survey—which ultimately covered about three-fourths of Rizal Province and nearly one-fourth of Bulakan. About 120 different sites were examined, and a few of the most important were explored extensively—others being explored in part only, with sections reserved for future more detailed work. The collections of this five-year period totalled nearly a half-million specimens, of which, unfortunately, about 75 per cent of the bulkier material wes destroyed during the recent war. Some specimens can of course be recovered from the Bureau of Science and Ermita ruins, but

they are all more or less damaged and the labels lost. Luckily, however, the full set of catalogues and field-notes was preserved, and a good cross-section of the entire collection still survives. Many of the rare specimens lost had been photographed and described in detail, and, although our negatives were lost, a fairly good set of file-prints still remains.

The Rizal-Bulakan area explored by myself, assisted by W. S. Boston, was divided into three main districts, known respectively as: I. Novaliches-Marilao; II. Central District; and III. Lake District. The collections for I and III were each kept as a single unit, but the Central District was subdivided into five smaller units, each with a separate catalogue. These subdivisions covered the San Juan River Valley, the Pasig-Tagig River Valleys, the Marikina-Puray River Valleys, the special Santa Ana Collection, and the Manila sites.

The various sites in the Novaliches-Marilao District were designated by single or double Roman letters, while those in the Lake District were designated by Arabic numerals. In the Central District the various subdistricts and sites were distinguished by the use of one or more key-letters in front of the number. For example, all Manila sites south of the Pasig River were distinguished by the key-letter "E" (because of Ermita being the first area explored); while, for convenience, those sites north of the Pasig River were distinguished by "EE–". Despite the great size of the collections, it was thus possible to avoid the use of very long numbers—which tend to be a nuisance and the source of frequent mistakes, in specimen handling. (As will be seen later, a still simpler system was adopted for Batangas Province—which was also applied to the Visayan Islands collections and to the Luzon tektite sites.)

It will be possible here to give only a very brief outline of the Rizal Province finds, and, for convenience, the three principal districts and the various subdistricts will be discussed separately.

I. NOVALICHES-MARILAO DISTRICT

A total of 29 separate sites were examined (some being divided into several areas), and they were designated A to Z, ZZ, YY, and XX, respectively.

Sites A, B, C, E, F, H, M, N, S, U, W, X, Z, and XX (14 in all) may be regarded as of major importance.

Sites D, G, I, L, R, V, and ZZ (seven in all) are of secondary, but considerable, importance.

While the remaining eight sites, J, K, O, P, Q, T, Y, and YY are of relatively little importance (although each has produced some interesting specimens or information), and may be disregarded in the present account.

The contents of the major and secondary sites may be indicated very briefly, as follows: (By horizons):

Early Palaeolithic.—Outcrops at Sites A, M, and X contain our oldest palaeoliths; associated with stegodon teeth and other fossils of probable Middle Pleistocene date, and in some cases with natural tektites.

Later Palaeolithic.—Scattered finds of other palaeoliths (mostly Pleistocene), and a few definite outcrops, occur particularly at Sites D, G, H, N–b, W, and XX. (Between Sites X and H, and again at Site G, there are pretty definite Late Pleistocene outcrops, containing numerous implements with recognizable characteristics.)

Mesolithic.—Sites G, I, Z, ZZ, and a few other minor localities, contain considerable quantities of pre-Neolithic obsidian and flint microliths (mostly early post-Pleistocene in date), and a few larger mesoliths. (Site Z is one of our best mixed Mesolithic and Eearly Neolithic sites, with practically no intrusion of material of either earlier or later date.)

Early Neolithic.—(Certain interesting protoneoliths, occurring at Site D and elsewhere, may be here regarded as a preliminary subclass.) The Novaliches-Marilao District contains the best and most extensive Early Neolithic deposits yet found in the Philippines, ranging in type from rather crude Bacsonian forms to fully ground axes and adzes of round or oval cross-section, and in date from about 4000 to 5000 B.C., down to 2500 B.C. or a little later. Sites A, B, D, F, G, H, M, N–b, S, V, W, X, Z, ZZ, and XX (15 in all) contain an Early Neolithic area or horizon, but only a few of them have concentrated deposits indicative of settlements. "Hospital Hill" at Site A, the western border of Site H, the eastern border of Site M, and parts of Sites D, G, N–b, X, Z, and XX, have produced the most and best specimens.

Middle Neolithic.—A few rare shouldered types, and a more numerous group of ridged (or "Luzon") adzes, are now recognized as a Middle Neolithic group (dating somewhere around 2000 B.C.), ancestral to the "tanged" and ridged adzes of Polynesia. Their distribution is sharply defined, covering a circumscribed but continuous area in three river valleys of the Rizal-Bulakan area (the San Juan, the upper Novaliches, and upper Marilao valleys), and a small area in Batangas Province. Sites D, G, H, M, N–b, S, V, W, X, and XX, have all produced good specimens of this type in small quantities.

Late Neolithic.—Plain-backed, transitional, and early stepped Late Neolithic adzes, chisels, and the like (all rectangular or trapezoidal in cross-section) have a wide distribution in Rizal Province, but are always very limited in quantity, and nothing like the rich deposits of Batangas Province has been found here. Sites A, D, G, H, L, M, N, V, X, and XX, have all produced one or more good specimens, the largest numbers

coming from Sites H, L, and X. Site L is purely Late Neolithic (long chisels, barkcloth beaters, early stepped adzes, and other tools) and seems like a spot out of the Batangas culture. No nephrite (jade) tools occur in this District; but green jade beads of the Batangas types have been found at Sites K and L.

Bronze-Age artifacts.—No bronze celts have been found in the Rizal-Bulakan area; but bronze ornaments, very similar to the Batangas types, have been found in Early Iron-Age graves at Sites A, C, and H, in this district, and at site 13 and elsewhere in the Lake District. (The Site 13 extensive deposit is probably truly Bronze Age, as will be hereafter indicated.)

Prehistoric Iron Age.—(*a*) Early Iron Age (2nd or 3rd century B. C., down to 3rd or 4th century A. D.); (*b*) Late Iron Age (4th to 9th century A. D.): Sites A, C, and H contained extensive and rich Iron-Age deposits, unmixed with any later material but only with earlier Stone-Age remains. All three localities contained Iron-Age burial grounds combined with village sites—and we excavated large areas at each site. We found that jewelry, weapons, tools, pottery, and other material were buried with the dead—and especially the graves of the wealthy or chieftain class produced objects of great interest, and often of artistic merit. The four great new industries were metal working, pottery making, glassmaking, and weaving. The latter art was discovered and studied through the existence of cloth imprints in the rust cakes of iron tools and weapons, placed in the same grave. Gold, silver, copper, bronze, and lead were all used to some extent, chiefly for ornaments. The early pottery is often covered with incised or perforated designs, and only the Late Iron-Age pottery is slip-covered and plain or with molded designs. Site C had most extensive Early Iron-Age deposit; Site A was about one-third Early and two-thirds Late Iron Age; while at Site H over three-fourths of the area was chiefly Late Iron Age.

In addition to the three sites already mentioned, Sites B, E, I, M, and possibly one or two others, had small Iron-Age deposits associated with later material.

Special Iron-Age jar-burial culture.—(About 3rd to 10th century A.D.?) Does not occur in the Novaliches-Marilao District.

Porcelain-Age remains.—(*a*) Early Monochromes (9th to 12th century A. D.); (*b*) Later Monochromes (13th and 14th centuries); (*c*) Ming period (15th to 17th century); and (*d*) Spanish period and modern.

(*a*) Part of Site B, Site E, and parts of Sites M, S, U, and W, all contain Early Monochromes in varying quantity. Part of Site B also contains a large cremation-type burial-ground, with several whole porcelain pieces in each grave. Site E is an old village site of Sung date.

(*b*) Sites B, M, S, U, W, and XX, all contain a stratum of Later Monochromes, sometimes mixed with or overlain by

Ming ware. (At Site B many Thanh-hoa and other Indo-China wares occur, as well as Chinese.)

(*c*) Site F is the best Early Ming-period site, dating mostly from the 15th century; but Sites M, S, U, and W, all contain some Ming material mixed with earlier monochromes. This whole district appears to have been largely depopulated during the Middle and Late Ming periods (16th and 17th centuries).

(*d*) Very few early Spanish-period remains have been found in this district, and it is not until the middle 18th century, or after, that extensive reinhabitation appears. Historic remains of 18th and 19th century date are found chiefly in parts of Sites D, J, K, O, P, and other less important places. Certain fragments of "Manila-ware" vessels, clay-pipes, and jars have the chief distributional interest.

(II. Central District: For convenience, discussion of the much subdivided Central District will follow the Lake District.)

III. LAKE DISTRICT

Seventy-one sites were examined, of which some 14 were excavated partially or extensively. The quality of the various sites may be estimated as follows:

First class.—Sites 5, 7, 11, 13, 15, 17, 22, 24, 34, 52, 54, 57 and 63 (or 13 in all). (Not all of such sites have been completely explored.) (Sites 13, 17, and 24 were most productive in specimen quantities.)

Second class.—Sites 2, 3, 8, 16, 21, 23, 31, 32, 33, 35, 36, 38, 42, 43, 45, 53, 56, 58, 68, and 71 (or 20 in all). These are good sites, but smaller; a few partly excavated. (All have contributed information of value.)

Third class.—Sites 6, 9, 10, 14, 18, 19, 27, 37, 41, 44, 48, 55, 59, 60, 67, and 69 (or 16 in all.) (These sites should mostly be further explored.) (Some important specimens have been obtained from all these sites.)

Of little importance.—Sites 1, 4, 12, 20, 25, 26, 28, 29, 30, 39, 40, 46, 47, 49, 50, 51, 61, 62, 64, 65, 66, and 70 (or 22 in all). (A few are worth further exploration.)

The contents of the above sites may be classified briefly as follows:

Palaeolithic.—Some early palaeoliths and natural tektites (but no important fossils) found in Sites 19, 24, 42, 53, 58, 60, and 63; good later palaeoliths in Sites 18, 23, 43, 55, and 57 especially.

Mesolithic.—Extensive deposits of pre-Neolithic obsidian and flint microliths, etc., in Sites 18, 21, 22, 27, 57, and 63; and less quantities in several other areas. (These Lake District Mesolithic sites are the best yet found in the Philippines—except, perhaps, the Kubao sites of the Central District, to be discussed hereafter.)

Protoneoliths.—Found in considerable numbers in the Tanay River Valley; see especially Sites 23, 38, 43, 54, etc.

Early Neolithic.—Scarce in the Lake District, except in the Baras and Pililla River Valleys; see chiefly Sites 17, 22, 24–b, etc.

Middle Neolithic.—(Typical ridged and shouldered specimens are wholly absent in the Lake District; but some interesting transitional forms between Early and Late Neolithic exist.)

Late Neolithic.—Adzes, chisels, and barkcloth beaters (horned), of fairly typical forms, are found in several widely separated parts of the Lake District, but in very small quantity. One nephrite chisel and three fully stepped adzes (similar to Batangas types) have been found. See especially Sites 19 (horned barkcloth-beater, etc.); 22, 23, 24–b, 34 (unique red stepped adze); 53, and 54 (well-stepped adzes); etc.

Bronze-Age artifacts.—One part of Site 13 has an extensive deposit of Bronze-Age jewelry, ornamental objects, and possibly fragments of a few tools, etc. (but no celts or spearheads yet found). Sites 11 and 17 also contain a few pieces of Bronze-Age type jewelry.

Prehistoric Iron Age.—Site 17, our largest and richest site in this district, contains a distinct Iron-Age horizon unmixed with other cultures; and Sites 3, 5, 7, 11, 24–c, and 36 all have interesting Iron-Age deposits, in contact with early Porcelain-Age cultures. In two or three other sites (see 35, 53, 59, especially), interesting fragments of Iron-Age jewelry and other artifacts have been found. (Sites 5 and 17 contain the largest quantities of Iron-Age beads; etc.) The Lake District Iron-Age deposits are mostly, if not wholly, of Middle or Late Iron-Age dates.

Pre-Spanish Porcelain-Age sites.—(*a*) Tang-Sung Early Monochromes; (*b*) Later Sung and Yúan Monochromes; (*c*) Early Ming-period wares (15th century); (*d*) Middle Ming ware (16th century):

(*a*) *Early Monochrome period.*—Parts of Sites 5, 7, and 17, especially. (Site 7 offers the greatest variety of early types—mostly from an old village midden, plus also a few graves containing whole pieces.)

(*b*) *Later pre-Ming monochromes.*—Sites 5, 17, 22; plus parts of Sites 11, 33, 36, and a few minor localities. (Site 22 contains one of the best assortments of later monochromes to be found anywhere in Rizal Province, and is almost completely free of any admixture of later material.)

(*c*) *Early Ming wares.*—Parts of Sites 11, 17, and 24, plus Sites 45, 53, and 55 are good examples, with several minor localities. (Site 24, in certain areas, contains the greatest quantities of unmixed material in village middens; while buried whole pieces have been recovered from graves in Sites 11, 45, and elsewhere, in small quantity.)

(*d*) *Middle Ming wares.*—Very large midden deposits of 16th century Ming wares, in great variety, are found in Sites 13 and 15, with practically no earlier or later wares mixed in. (Also parts of a few other smaller sites.)

Spanish period and historic remains.—(*a*) Late Ming and 17th century; (*b*) 18th–19th century and modern:

(*a*) *Late Ming and other 17th century remains.*—Site 16, for ceramic wares; Site 17, for beads, other jewelry, and miscellaneous artifacts; parts of a few other sites (especially Sites 8, 20, 56, etc.).

(*b*) *Eighteenth Century to modern.*—Sites 8, 9; parts of 16, 17, and 14; 25, 56, etc.

II. CENTRAL DISTRICT AND SPECIAL SITES

It will be most convenient to discuss each of the five subdistricts or special sites completely under its separate heading, but in a more generalized manner than was adopted for the other districts.

Although only about 20 sites have been allotted to the Central District, several of them were divided into several areas each, while the Manila sites (counted as a single group) were subdivided into a large number of special areas and subareas. (We here do no more than list them, with a very generalized indication of their contents.)

1. *San Juan River Valley Subdistrict.*—Eight original sites, numbered SJ–1 to SJ–8. Only SJ–3 and SJ–5 remained of permanent importance; although a number of good specimens were found in nearly all of the others (notably our best specimen of the Middle Neolithic "Luzon" ridged adze, from SJ–2). Four of the original sites were afterwards (during the 1931–1941 period) incorporated either with Manila or with the special Santa Mesa and Kubao sites, to be discussed hereafter.

Site SJ3.—Covering the townsite of San Francisco del Monte, this site contains three groups of interesting material: First, a large dome-shaped low elevation known as "Buck's Hill," containing an extensive deposit of Middle and Late Neolithic artifacts, consisting of a few fragmentary or damaged adzes associated with large numbers of much-used or worn flaked implements made both of obsidian and of tektite natural glass. (Arrow or dart points, drills, scrapers, small knives, and combination tools, are the commonest types.) Second, an area containing a considerable quantity of 16th and 17th century ceramic fragments (both imported and local), indicating a village site of that period. Third, a group of ruins consisting chiefly of early Spanish stone buildings, known to have been destroyed during the "Chinese rebellion" about 1640, and never rebuilt.

Site SJ5.—Known as "the Tuason Site," this place was apparently an ancient trading-station located at a much-used crossing of the San Juan River. There appear to have been Late Neolithic "stations" or small villages on both banks of the river, and along a small creek that enters the river at this point. (A few well-finished

rectangular adzes and chisels, associated with many flaked implements of obsidian, flint, chert, etc., are found.)

After the Late Neolithic there are no signs of occupation until the 15th century when another small village existed, chiefly on the west bank, until the Spanish occupation in the late 16th century, after which it also disappears.

2. *Pasig-Tagig Subdistrict.*—(Covering the whole area south of the Pasig River, through the Tagig Valley, and along the Lake shore through Bagumbayan and Sukat as far as Alabang.) Seven original sites, numbered PT–1 to PT–7. Only three of these (PT–2, PT–4, and PT–7) have been extensively developed, although a few interesting specimens have come from all (notably the three nephrite adzes mentioned on p. 231, par. 4, from Site PT–1).

Site PT–2: San Pedro Makati; (*a*) Greek-coin area (see p. 231, par. 7, already discussed); (*b*) Manila-ware kilns: Three kiln-sites of 16th to 18th century excavated, and large quantities of "Manila-ware" fragments obtained.

Site PT–4: Tagig Cemetery Area. Ancient village site and burial ground of Tang-Sung Early Monochrome period partly excavated, and many good fragments and a few whole pieces obtained. (Similar to Santa Ana.)

Site PT–7: Bagumbayan Site. A few Late Neolithic stone adzes and chisels, associated with large quantities of flaked obsidian and flint implements. (A large site, near Lake shore, occupying nearly a square kilometer of gently rolling hills and grassland.)

3. *Marikina-Puray Subdistrict.*—Three original sites, numbered MP–1 to MP–3. Of little importance as yet, except part of MP–2 ("Sung grave Area"; see p. 231, par. 3, *ante*). (This whole subdistrict warrants further extensive exploration, for which time has not yet been available.)

4. *Special Santa Ana Site.*—A special site, consisting of three areas some distance apart, covering a part of the location of the old Kingdom of Sapa, of pre-Spanish times. A special catalogue was set up for this collection, which is of good size and quality. The excavations included a few graves, an ancient shell-heap, and several sections of village middens. Area 1 was inhabited from the 9th or 10th century, A. D., down to the 14th century (under Empire of Sri-Vishaya). Area 2 was inhabited chiefly during the 15th and early 16th centuries (under Madjapahit and Brunei).

Many interesting objects were found in this site, that distinguished it clearly from all other sites except that of Tagig PT–4 above).

5. *Special Manila Sites.*—(Although properly included in the Rizal-Bulakan Collection, the Manila City area will in the

present paper be treated as a separate province, and as such will be discussed as No. 26 below.)

Later period (*sporadic exploration,* 1931–1941).—Minor additions were made to the Rizal-Bulakan Collection throughout the following decade, and a new series was begun for the Novaliches-Marilao District (distinguished by the key-letter "N–"). No other important changes were effected, but four new special sites were set up, the first two of which proved extensive and important enough to be each given a separate new catalogue:

1. *Special Santa Mesa Tektite and Archaeological Site.*—Discovered by Fidel Mayson in 1935, this soon proved to be one of our most important areas of exploration—and an extensive collection, totalling several hundred thousands of specimens, was built up during the following years. Contents include small numbers of Middle and Late Pleistocene palaeoliths, great numbers of tektites and pseudo-tektites, small numbers of Mesolithic and Neolithic artifacts, and limited areas containing Porcelain-Age deposits of late pre-Spanish and early Spanish dates. (Due to certain geological movements and changes in the area, a great deal was learned about the weathering and patination of tektites and palaeoliths under certain conditions.) As this site lies along or near the eastern and northeastern edges of Manila City, it was readily accessible and could be explored more or less continuously.

2. *Special Kubao Tektite and Archaeological Site.*—Discovered by myself, accompanied by Mr. E. D. Hester, in January, 1936, this ultimately proved to be one of our largest and most informative tektite and Early Stone-Age areas of exploration. It lies just to the east of the Santa Mesa Site, in the area then known as "New Manila" and now called "Quezon City." (The extensive road-building and real-estate development going on there, aided greatly the ease of our exploration.)

Here, for the first time, we found considerable areas of undisturbed geologic deposits—with both tektites and early stone-implement types in place. In the lower strata we found a few interesting Pleistocene palaeoliths in the same layer with undisturbed tektites, while in two layers above, we found a rich deposit of flaked mesolithic semimicroliths in an undisturbed stratum of red lateritic clay. The upper soil layers are mostly barren, and indicate little or no inhabitation of the area in Neolithic and later times—at least until the middle 18th century.

3. A small tektite and early stone-implement area, known as *Baesa,* lies just to the north of Manila, near the Rizal-Bulakan boundary. Contents similar to Kubao, but very much scattered and scarce. Further exploration is warranted, in some areas.

4. *The Navotas-Malabon Site.*—Navotas is a long, narrow, spleen-shaped island, in the municipality of Malabon and inhabited largely by fishermen. It is interesting ethnographically on account of the many types among the thousands of small watercraft that line the shores.

It is interesting archaeologically because of two facts: First, it appears to have been a landing-place or trade-center for Arab and Chinese merchantmen in the Late Tang and Early Sung periods (9th to 12th century A. D.); and considerable numbers of ceramic fragments have been found in certain sand-dunes along the shores. Second, the grounds around certain ancient ruins of Spanish stone buildings, near the south end of the island, have yielded many interesting fragments of 16th and 17th century ceramic wares—chiefly Chinese.

Further study, and some excavation, of the Tang-Sung ceramic-fragment area was interrupted by the war, and should be resumed in the near future.

Workers.—(As indicated under the preceding various items.) Main survey conducted by H. O. Beyer and W. S. Boston, assisted in various ways by Wm. H. Brown, E. D. Hester, A. V. H. Hartendorp, James V. Pappa, Gordon & Haley, Paul Mack, F. P. Domingo, Rafael Palma, and others.

26. *Manila City: (a) North of the Pasig River; (b) south of the Pasig.*
(*a*) *North of the Pasig* (*key-letters "EE"*).—Twelve separate individual sites or areas explored, as follows:

EE–1: A Chinese building at corner of Pinpin and Dasmariñas.
EE–2: Cosmopolitan building site, near Sta. Cruz Bridge.
EE–3: Great Eastern Hotel Site, Calle Echague.
EE–4: Heacock building, corner David and Escolta.
EE–5: Insular Life building, Plaza Cervantes.
EE–6: Reyes (now Soriano) building site, Plaza Cervantes.
EE–7: Uy Yet building (China Bank Area), Calle Dasmariñas.
EE–8: Cu Unjieng building site, Escolta and Pinpin.
EE–9: Ideal Theater building site, Rizal Avenue.
EE–10: Trade and Commerce building, Calle Juan Luna.
EE–11: (Miscellaneous street excavations.)
EE–12: Santo Tomas University Campus ("Bill's Site"), España.

(*Contents:* Excavations for building sites proved very interesting and informative regarding the history of Manila. Accurate chronology worked out for downtown area, showing regular subsidence of around 14 inches per century. Good series of datable Chinese and European porcelains obtained in great quantity; also contemporary native and southeastern Asia wares. Some whole pieces found as well as fragments and sherds.)

(*b*) *South of the Pasig* (*key-letter "E-"*).—Fourteen separate individual sites or areas explored to some degree, and a few of them excavated extensively:

E-ESG: Ermita School Garden (Agriculture and Commerce building), Wallace Field.
E-LLT: Laong Laan Tennis Court area, Wallace Field.
E-LD: "Luis Dato" area, east of Tennis Court, Wallace Field.
E-WF: Wallace Field, in general.
E-IP: Calle Isaac Peral area (Taft to M. H. del Pilar).
E-UP: University of the Philippines Campus; especially area near Florida.
E-WB: Weather Bureau and Ateneo grounds.
E-BS: Bureau of Science grounds (and fishpond area).
E-MW: Manila Walls and Moat area.
E-WC: Various excavations inside Walled City.
E-PO: Post-Office building site.
E-MT: Metropolitan Theater building site.
E-CB: Colgante Bridge area (south approach, Quezon Bridge).
E-CH: New City Hall site.

(*Contents:* The Post Office, Metropolitan Theater, and Colgante Bridge areas were very deeply excavated, and produced enormous collections of interesting ceramic and other material from the old Chinese Parian of the late 16th and early 17th centuries. Little modern material, except in upper soil layers.)

The Ermita School Garden and most of the various Wallace Field areas lie on the site of old Bagumbayan—the "New Town" built in the last third of the 16th century by the Manila natives ejected from the pre-Spanish town by Goiti and Legaspi. Many interesting types of native pottery, "Manila-ware," clay-pipes, coins, beads, native jewelry, and other articles, have been found.

The Ermita area was probably made up largely of sand-dunes of various sizes, in pre-Spanish and early Spanish times. Some excavations show the remains of such dunes, and occasionally they contain interesting old objects, particularly on Isaac Peral, Florida, near the Weather Bureau (Ateneo), and the Bureau of Science. Deep borings for setting up telephone and electric-light poles have also often brought up interesting objects—along several streets in this area.

General history of the Manila area.—Results of our exploration indicate that downtown Manila was inhabited only from about 1480 or 1500 onwards. The really old part of the area lies up the River, and has been explored by our special Santa Ana Site—already listed under Rizal Province.

Workers.—H. O. Beyer, Anacleto Manuel, J. P. Bantug, G. E. Miller, Walter Robb, Salt and Heistand, C. Bauer, I. Cohen, Juan Nakpil. (For additional data see Addendum.)

27. *Cavite Province:*

Stone-Age remains.—Several plowed fields (mostly with red soil) along the main road to Tagaytay, and others near Indang, have produced small numbers of obsidian and flint microliths, while excavation near the Manila Hotel Site at Tagaytay Ridge produced a good Late Neolithic barkcloth beater. (A few other obsidian and flint microliths, probably of Neolithic date, were picked up along the trail to the Diesta Site to be described later.)

Possible Iron-Age site.—A thin layer of small sherds of common red pottery was examined in the back wall of a sizable excavation near the Van Schaick residence on Tagaytay Ridge. No associated objects were found, but the pottery itself is almost identical with the Early Iron-Age material from the Novaliches District sites. (This vicinity should be further examined, both for additional Late Neolithic remains and for possible Iron-Age artifacts.)

Porcelain-Age sites.—Only one important pre-Spanish site has been investigated—that on the Diesta Farm, in Pañgil barrio, about half-way between Amadeo and Indang, and accessible by trail only. About 10 whole pieces of 15th and early 16th century Ming wares were accidentally excavated when a sizable ditch across one end of the farm was being dug; and a later visit by E. D. Hester disclosed the presence of good midden fragments, from a nearby village site, being plowed up in the surrounding fields. One sizable piece of a 15th century Sawankhalok tall jarlet was also plowed up. Mr. Hester expressed the opinion that a ton or more of midden fragments might easily be gathered from the plowed fields seen by him in 1932.

Hester's original visit had been made from Indang, on horseback, but in 1940 he and I tried again to reach the site from Amadeo—going by car nearly to Pañgil barrio, and then on foot for several kilometers. We found the midden-filled fields now overgrown by tall grass and brush—as cultivation had been shifted to other fields—but we did gather a small bagful of fragments from two adjoining new fields. These appear a little older than the first finds, and indicate that the upper side of the village site began at least as early as the 14th century. (The whole area looks very interesting, and merits further exploration and search for other sites.)

Historic sites.—The whole Cavite coast, from old Cavite town as far south as Ternate, was the seat of important happenings in the Early Spanish régime (and before), and should contain important historical remains meriting exploration. (Also Buck's fire-walkers.)

Workers.—E. de Mitkiewicz, Robert L. Pendleton, H. H. Buck, E. D. Hester, H. O. Beyer, Tomas Tirona.

28. *Batangas Province:*

Next to the Rizal-Bulakan area, Batangas Province has proved to be the most important archaeological area yet discovered in the Philippines, and, as regards its uniquely rich Late Neolithic remains, one of the most remarkable Late Stone-Age sites found anywhere in the world. Our systematic exploration, lasting for nearly a decade (1932–1941), is now known as the Batangas Archaeological Survey, and has been recorded in a special catalogue running to some eight volumes. The area explored is a continuous one, covering a little more than 120 square miles—including practically all of the municipalities of Cuenca, Alitagtag, Taal, San Luis, Bauan, and bordering parts of Batangas, San José, and Lipa.

Before the results of the systematic Survey are taken up, finds in other parts of Batangas Province will be briefly considered:

Batangas finds outside systematic area:

In 1920 a tenant-farmer while digging a well near Lake Taal, inside Lipa municipality, found a brown-glazed Chinese jar containing a remarkable bronze image of Oriental type and rather crude native manufacture. Both jar and image appear to be definitely pre-Spanish, but of uncertain date (Early Ming or pre-Ming, apparently).

In February, 1921, three interesting stone implements were found by myself and Major Eugene de Mitkiewicz in a field near Tanauan, and Mitkiewicz also obtained a small Early Ming dragon-jar that had been excavated by a farmer in a field near Lake Taal. One of the stone implements was the first Middle Neolithic shouldered axe to be found in the Philippines; while a second was a peculiar sharpened small quartz disk of a type exactly similar to others later found in the Late Neolithic systematic area.

In 1934 I briefly explored the original Lipa townsite in Balete barrio destroyed by the great eruption of the middle 17th century. Interesting Middle and Late Ming midden material was found in several plowed fields, on a low ridge several hundred meters distant from the ruined church. A good-sized pre-Spanish village was apparently located there for at least a half-century or more before the Spanish occupation. A small Stone-Age community probably also existed—since in an orange grove on a nearby hill some 25 flaked obsidian implements were picked up. (The area should be explored further.)

Some time in the middle 1930s a Bureau of Science employee found two good stone axes and several pitted stone hammers in a barrio of Lemery.

In 1936, in the barrio of San Pedro of Batangas town, a creek running into an old river bed exposed several Early Ming porcelain dishes, buried at a depth of about 2 meters. The pieces were obtained by Melecio Arceo, of Batangas, and two of them were later brought to me at Manila by Miss

Remedios Abdon. They are blue and white 15th century Chinese pieces, in good condition. It seems evident that there is an Early or Middle Ming burial ground in this vicinity that should be further investigated.

In 1940 Pedro Malabanan, of Bulaknin barrio, Lipa municipality, found a fine specimen of medium-large nephrite Late Neolithic adze (plain-backed) on his farm; and later found two others of slightly different color and form. The first specimen was brought to me in Manila by Miss Emilia Malabanan, but the two others have not been seen. They are interesting as being the farthest north of any similar specimens yet found in Batangas.

Tektites.—In February, 1928, an interesting whole tektite was found near Ibaan, in a field also containing obsidian flaked implements and cores, and was sent in to the Bureau of Science for identification. In October it was turned over to me by the Director, after I had identified it as a tektite; and is preserved as our first recorded tektite specimen from Batangas Province.

Fr. Miguel Selga, who had seen the above specimen, started his weather observers looking for tektites elsewhere in the province, and they were able to find several in the barrio of Rosario, also in Ibaan. Some of these tektites were sent by Fr. Selga to Prof. A. Lacroix, of Paris, who had one of them analyzed, and in 1931 published a short paper on the Batangas specimens.

Other tektite finds from the systematic area will be mentioned later.

Batangas west coast.—Two areas have been explored on the west coastal area: (*a*) the Nasugbu-Lian area; and (*b*) the Calatagan Peninsula.

(*a*) *Nasugbu-Lian area:* In the early 1930s Anacleto Manuel found three good Porcelain-Age pre-Spanish sites in the Nasugbu-Lian area, and made a considerable collection of good midden fragments. Mostly the material is 14th and 15th century Early Ming, and is notable for having some Sawankhalok fragments mixed in. (Further exploration seems warranted.)

(*b*) *Calatagan Peninsula.*—In 1934, at the sitio known as Bolombató, on the Zobel Estate, there was partly exposed an ancient pre-Spanish burial ground of the 15th and 16th centuries—most of the graves containing whole porcelain pieces, jewelry, and utensils, as well as fairly well-preserved skeletons. In certain cane-fields, and in another area where the ground was being smoothed for a polo-field, the middens of two or more old village sites were also exposed. Here, in addition to much pre-Spanish material, there were also found Spanish-period objects (including coins) of the 16th and

17th centuries. Chinese coins of the Ming dynasty were also found. Most of the porcelain ware is undoubtedly of the 15th century, although some 14th and 16th century material is also in evidence (both Chinese and Sawankhalok types being found). Glass bracelets and beads predominate among the jewelry; also several gold objects are said to have been sequestered or stolen by the workmen. Some porcelain pieces were also disseminated, and some were kept by the Zobel family, but a majority of the material found was turned over by Mr. Enrique Zobel to the National Museum.

Ricardo E. Galang visited the site for the National Museum, and collected considerable midden material. He also found several Neolithic stone implements in the cane-fields. They mostly resemble the Late Neolithic adzes and chisels from the systematic Batangas area, but only one was stepped.

In 1940 Olov T. Janse, Swedish archaeologist, excavated nearly 60 graves in three different burial sites, in the Calatagan area, known as Pinagpatayan, Pulo Bakao, and Kay Tomás. A large collection of Early Ming porcelains, both Chinese and Sawankhalok, was obtained, as well as jewelry, weapons, utensils, etc., including spindle-whorls in female graves. Some bodies had been beheaded and in one case the head was replaced by a porcelain bowl. One grave contained a skull with gold-inlaid teeth, similar to those commonly found in cave-burials in certain Visayan islands. A few of the earlier graves might be of Late Sung or Yuan date, as they contained no blue-and-white wares. Near the Kay Tomás burial-ground, a few Late Neolithic stone implements were found in the ground.

Most of the Janse material was shipped to the Fogg Art Museum at Harvard, but a considerable number of pieces were kept at Calatagan by the Zobel family. (See Addendum for further data.)

The Batangas Archaeological Survey (1932–1941).—The first important site in the systematic area was discovered by the late Capt. F. G. Roth in the early part of 1932, while I was absent from Manila on a six-week trip to northern Indo-China and South China. Roth contributed greatly to our subsequent exploration, down to the end of 1937; and the results stand as a fitting memorial to his name.

The last collected lot of the systematic exploration was delivered in Manila on December 2, 1941—less than a week before the outbreak of the war. Luckily, 80 per cent of the Batangas material survived the conflict—and it stands today as our best single collection, and one of the finest of its kind ever made anywhere.

It consists of 232 separate deliveries or small collections, containing a total of 8,505 separate packages to each of which a single number was given (preceded by the key-letters "BM-"). The size of each package varies from a single specimen up to several hundreds, so that the total collection comprises more than a quarter of a million pieces.

Roth's original site, at Makulut barrio of Cuenca, contained only Late Neolithic material, but as our collecting ground spread gradually southward through Alitagtag and Bauan, and westward to Taal, new horizons began to crop up, and by 1935 we had a full Stone-Age series from Early Palaeolithic to the latest Neolithic and the Bronze Age. True prehistoric Iron-Age and early Porcelain-Age remains are very scarce—absent, in fact, from most of the systematic area, and where found are confined within very limited and definite boundaries. The true modern period begins only in the 14th or 15th century, from which time the population was continuous and gradually multiplying down to the Spanish occupation and after.

The Late Neolithic culture runs throughout the systematic area of Batangas, and was the basic characteristic of the largest and most widely distributed population. The other Stone-Age and later cultures are of much more limited extent, and crop up chiefly in circumscribed areas in different parts of the systematically worked region. The different horizons identified and their chief characteristics are hereunder briefly discussed:

Palaeolithic remains.—While several scattered early palaeoliths (mostly of chalcedony or quartz; see BM–858, BM–8387, etc.) had been picked up in the course of our collecting, it was not until the end of 1938 and beginning of 1939 that we located a true Palaeolithic site of definite Pleistocene date. We had noted for sometime that many flaked Mesolithic and Neolithic implements—especially those coming from the northeastern part of Taal municipality—showed large patches of older worked surfaces, as though they might be re-worked palaeoliths. But in the last lot for 1938 there came a package from a collector in Sampa barrio of Taal, containing whole specimens of Palaeolithic choppers, or handaxes, showing the original worked surfaces undamaged throughout This led to the discovery in that barrio of a true Late Pleistocene outcrop containing whole palaeoliths— and a brief preliminary exploration of it was made in 1939–1940. Tension leading later to war prevented our plans for more thorough exploration from being ever carried out, and the site still remains improperly investigated.

Mesolithic artifacts (chiefly of obsidian and fine-grained basalts).—Considerable numbers were found in certain parts of the Batangas systematic area. They are of two basic types, widely different in character: (1) A large type, showing some kinship to the Hoabinhian and Sumatra-type late palaeoliths of southeastern Asia; and (2) a class of semimicroliths (chiefly of obsidian and fine-grained basalts).

Natural and worked tektites.—Natural whole tektites have not so far been found inside the systematic area (although they occur in limited numbers in Ibaan municipality nearby); but cores and flaked implements of tektite glass are found in small quantity among both the mesoliths and early neoliths. They have probably been transported from Ibaan, or from some other more productive site not yet located.

Early Neolithic remains.—Most of the Early Neolithic axes, adzes, chisels, etc., so far found in Batangas show signs of reuse by the Late Neolithic folk. Some are merely repolished without change of form; but many others have been partially or wholly re-ground into approximations of rectangular-adze forms. Some have, in fact, doubtless been so thoroughly reworked as to conceal their origin; and have thus been usually classified by us as ordinary Late Neoliths. However, the total number of identifiable specimens is considerable, although forming only a small fraction of the true Late Neoliths. (One factor aiding identification is the material—since Early Neoliths are usually of andesite or schist, while true Late Neoliths are of harder and different stones.) This extensive reuse renders difficult any proper distributional studies; nevertheless from our work to date it is possible to state that the Early Neolithic culture was much less widespread than the Late Neolithic, and that it centered around certain definite areas rather widely separated. The original culture appears to have been quite similar to, and probably contemporary with, that found in Rizal-Bulakan. It is still doubtful as to whether or not the Early Neolithic folk had barkcloth beaters of stone; but they certainly appear definitely in the Middle Neolithic, although not fully developed and diversified until the beginning of the Late Neolithic period.

Middle Neolithic remains.—If the Middle Neolithic ever existed in Batangas as a separate period, it was certainly a short one and of quite limited distribution. Nevertheless, several very characteristic shouldered and ridged specimens of Middle Neolithic types have been found, and the few Batangas ridged specimens are even more definitely transitional to Polynesian and East Pacific forms than are those of Rizal-Bulakan. The stone materials used, however, correspond more closely to the Late Neolithic than to the Early—which is just the opposite from the Rizal-Bulakan Middle Neolithic. (It is possible that the actual mixing of the Middle with the Late Neolithic culture occurred on the mainland, as Heine-Geldern has already suggested, and the Middle type-forms appeared in Batangas with the first phase of the Late Neolithic, rather than earlier.)

Late Neolithic period.—As has already been several times indicated, the systematically explored Batangas area is basically a rich Late Neolithic site. The specimens collected run literally into the hundreds of thousands, and it will be possible here to give only a brief suggestion of the great variety of types

found. It is possible to identify certain chronological phases, which may be given separate consideration:

First phase: The early Nephrite Culture.—The first appearance of the Late Neolithic in Batangas is marked by the presence of large numbers of large and small adzes, chisels, gouges, groovers, awls, and other small woodworking tools, all made from ancient jade or nephrite, originally translucent but now usually altered into an opaque white material that ultimately disintegrates into a kaolinitic powder. (The original color of the translucent nephrite was usually white, or white streaked and clouded with green; but occasionally it appears in a mottled yellow to reddish brown, and rarely even as a greenish black. One altered mottled form is known as *agalmatolite*—and this also occasionally appears in our Batangas sites.) Other stone materials appear, but they are much less numerous in proportion. In the first phase, there are at least three nephrite artifacts to one of any other ground or polished stone material. (This qualification is necessary, for the reason that together with the polished and ground artifacts—throughout the Neolithic—there appear also numerous flaked implements of obsidian, chalcedony, and other materials, a microlithic or semimicrolithic culture doubtless carried over from pre-Neolithic days.) All polished artifacts of the 1st phase are plain-backed, without any shouldering, stepping, or tanging of the butt (except in the case of spearheads, which all have tanged or shouldered butts for mounting).

Second phase: Nephrite decreasing, and transitional types appearing.—Less than half the tools are of nephrite, somewhat better preserved, while grey and black stone specimens increase in number. Butts are now shaved or transitional in type—even a few of the nephrite specimens being so treated. Spearheads increase in number and variety, and stone barkcloth beaters are everywhere in evidence. A greater variety in size and shape of small wood-working tools, both of nephrite and of grey stone material.

Third phase.—Nephrite tools become scarce, but other tools increase in number and variety. Early stepped forms become the dominating types in adzes and chisels, practically all of grey or black stones, well polished. Increasing use of nephrite jewelry, mostly green.

Fourth phase: Hole-boring and sawing period: "Jade cult."—Fully stepped adzes of very hard stones shaped by sawing. Some with perforated butts. Jade (green nephrite) confined to jewelry and ornamental objects (beads, earrings, amulets, and some curious objects of uncertain use). Barkcloth beaters with sawn grooves. All tools finely polished. Stone saws and drill-points mostly of schist. Some religious (?) objects or ornaments.

Source and dates.—These Late Neolithic cultures all appear to have come over directly from Indo-China or South China to the Batangas coast; 1st phase, about 1500 B. C.? 2nd phase,

1000 to 800 B. C. ?; 3rd phase 800 to 500 B. C. ?; and 4th phase, 500 to 250 B. C. ? However, the fully stepped adze (possible only after the sawing technique was introduced) was apparently developed in Batangas itself, since it is not found in fully stepped form on the mainland, although a few rare specimens from Dongson and Luang Prabang (and one adze from Hongkong) are close approximations.

Bronze-Age remains.—A few characteristic Bronze-Age remains form a very definite and interesting phase of the central Batangas culture, but also present some features that are still a bit puzzling. We have actually found four whole bronze celts (closely similar to some found at Hongkong and at Dongson), fragments of several others, one large fragment of a bronze spearhead (like Hongkong), and a number of pieces of interesting bronze jewelry and ornamental objects (some of which are ear-pendants)—and, curiously, most of them were found in close association with transitional adzes and other stone implements of the 2nd phase (about 800 B. C.). The scarcity of these objects (and the absence of tin in Luzon, although copper is present and has been anciently worked) led us early to believe that they all came over from the mainland with the original migrators, and that a further supply was not obtainable.

Equally intriguing is the origin of the Batangas nephrite. The great quantity of artifacts found led us to seek diligently for some possible local source of the material, but the results so far have been wholly negative. In fact, the marked variation in the quantity and use of nephrite, during the various chronological phases, clearly argues importation and a gradually diminishing supply. It seems most likely, therefore, that both the nephrite and the bronze used in the Batangas-culture area were either brought from the mainland by the original migrators, or were imported during the entry of later culture waves.

Iron-Age remains and the use of pottery.—A considerable majority of the Batangas Late Neolithic areas contain no pottery fragments at all—and we are still of the opinion that if there was any entry of pre-Iron Age pottery, it could only have been with one of the later phases and in only a very limited way. (There is a rather curious kind of coarse-grained pottery, with incised decoration, found in certain areas particularly rich in green jade ornaments of the last Late Neolithic phase. However, these same areas contain some scattered Iron-Age and pre-Spanish Porcelain-Age remains— and the proper association of the red pottery fragments is still a matter of doubt.) Considering the fact that the Indo-China Late Neolithic sites, and those around Hongkong, all seem to definitely contain a pottery culture its general absence from practically all Philippine Stone-Age sites is a bit puzzling, but no more so, perhaps, than its equally complete absence throughout all of Polynesia. (This is an additional interesting fact, besides many others, that link the Polynesian and the Batangas-type cultures.)

Within Cuenca municipality, and in two or three spots on hills and gently sloping ridges just to the southeast of the town, small midden deposits of probable genuine Iron-Age date occur. They contain a few scattered beads, bracelet fragments, and pieces of iron artifacts, in addition to numerous thin potsherds similar to the Rizal-Bulakan Early Iron-Age types. This seems to indicate that once there were several Early Iron-Age graves on top of these hills—which are now almost bare of earth, most of the original grave material probably having long since washed away.

No other specific spots containing remains of Iron-Age graves or midden heaps have yet been examined by me within the systematic area—although a few individual Iron-Age type beads, and occasionally a few pottery fragments, have been brought in by collectors from other areas. Some of these spots should be systematically examined in the future.

Porcelain-Age and historic remains.—As indicated on p. 246 above, most of the ceramic material—which occurs in several widely scattered barrios—seems to date chiefly from the 14th to the 16th century A. D. In other words, most of the material is Chinese Ming ware or contemporary red pottery of native origin, with a very few Sawankhalok and other Siamese fragments mixed in. Other factors of a semihistorical nature, which need not be gone into here, have led us to identify the people who left these remains with an incoming Malay group from North Borneo through Panay—and at least one branch of them spread onward into the Lake District of Rizal Province, while still other branches went eastward into southern Tayabas and the Bikol Peninsula. This phase of Batangas cultural history should be made the subject of a special study, as these Bornean-Panay people were probably the ancestors of a large proportion of the present inhabitants of Batangas Province.

Workers.—(See preceding various items.) The systematic work was wholly by myself and F. G. Roth; assisted to some extent by E. D. Hester, Ralph Busick, Esteban Rosales, and many local collectors.

29. *Laguna Province:*

(Despite its interesting location and probable rich archaeological content, this province has scarcely been explored at all. A few casual finds, accidentally made, will be recorded below.)

Late in 1945, H. R. van Heekeren, a Dutch archaeologist sojourning here briefly on his way home from a Japanese prison camp, found some 25 or 30 flaked obsidian and flint semimicroliths (of the usual Rizal and Batangas types) on a cultivated foot-hill of Mt. Makiling a short distance east of the Calamba-Tanawan highway.

On April 6, 1929, the late Dr. William H. Brown and Major Simmons, on a trip through eastern Laguna, found in the edge of the town of Lumban some children playing with a curious

carved stone head. Upon inquiry they found that the children had dug it out of a freshly cut nearby roadbank, about 6 or 7 ft. high—and they had already damaged the features of the head somewhat by pounding it with another stone, and digging at the eyes with a piece of iron. Doctor Brown acquired the head, and brought it in for my colletion. The head is carved on the back part of an old stone mortar, a little larger than a shelled coconut. The carving is rather crude but interesting; obviously of native workmanship. Age uncertain, but possibly pre-Spanish.

No other Pre-Spanish sites have yet been located in Laguna Province, so far as I am aware.

Workers: (As indicated above.)

30. *Southern Tayabas Province (now "Quezon")*: (See No. 18 for northern half of province):

Five prehistoric sites of accidental discovery are known, and at least three of them have been explored to some degree—although none of them thoroughly:

1. *Burdett Late Neolithic Site.*—On January 15, 1921, Mr. F. D. Burdett found a small well-polished Late Neolithic adze at the foot of a natural gravel-bank near the landing of the Richmond Petroleum Co., at the southern end of the Bondok Peninsula. (He did not have time nor tools to explore the bank further, but thinks that other interesting objects might readily be found there.)
2. *Cabalete Island, Mauban.*—Sometime in the early 1920s, Dr. Maria Pastrana, of the University of the Philippines Botany Department, brought to my attention the existence of certain caves on this small island—said to contain numerous skeletal remains, portions of wooden coffins, and quantities of broken pottery, stoneware, and porcelain, all of pre-Spanish types similar to those found in the caves of the Visayan Islands. The island belongs to the Roces family of Manila; and some years ago a member of the family and some private collectors visited the spot and removed some of the better-class material. Doctor Pastrana states however, that there are still quantities of ceramic fragments and other broken objects there—and it should be explored at an early date.
3. On May 20, 1930, one of my collectors, named Sofia de la Cerna, reported the discovery of the Kamahagin Barrio Site, Gumáka municipality, and brought in four good ceramic pieces collected there (three being whole, and one a large fragment). All of the pieces are of 14th or 15th century dates, and the site seems to be an old pre-Spanish burial ground—located on a small farm near Kamahagin. At least two graves were accidentally dug into and there are probably many others in the vicinity. (As Sofia had to return to Cebu, no further exploration was carried out.) The site is especially interesting because of one Sawankhalok celadon and a good Chinese 15th century "hole-bottom" dish that turned up.

4. *James Wright Site.*—In 1939 James A. Wright found some interesting ceramic fragments around a recently built house at the barrio of Piris (or Perez), on the eastern side and near the northern part of Bondok Peninsula. He gathered up a small package of fragments, and brought it to me in Manila. The material indicates an early Ming settlement, similar in date to No. 3 above and in character to those found in central and western Batangas. (Perhaps a few of our North Borneo-Panay-Batangas folk moving eastward ?)
5. *San Narciso jar-burial site.*—The most important and extensive site yet discovered in Tayabas Province is that located in the hills and along the shoreline near the town of San Narciso, about halfway down the eastern side of the Bondok Peninsula. It was first reported (both to the University and to the Bureau of Science) in 1932 by D. Argosino, Jr., and Bayani Fontanilla; but was not seriously investigated until July–August, 1938, when Ricardo E. Galang, of the National Museum, explored the site and found a large number of very interesting jar-burials of early date. Several unusual jar-burial types were found—one of them being characterized by the use of a heavy grooved stone cover for the jars; apparently designed to keep wild pigs and other animals from disturbing them. Other jars were found near the seashore at a place called Recudo, and two were carefully excavated. Nine other jars are reported to have been excavated by the people here.

   Six other jar-burial and midden sites were found in the vicinity—one being in a damp cave and three others near the seashore. The most potentially interesting is the barrio of San Andres, where many shell bracelets and several gold ornaments are reported to have been formerly dug up by the people. Galang found 6 shell bracelets, some beads, and several pieces of 14th and 15th century porcelains there (one piece being Sawankhalok). At another site called Tala, a glazed Chinese jar (early Ming ?), containing some bone fragments, was found. It thus seems probable that jar-burials of two or three different periods and types exist in this area—and further exploration should certainly be carried out.

Workers.—(As indicated under the foregoing various separate items.)

31. *Camarines Norte Province; (including also some data on Camarines Sur).*

(A good part of this province is still wild and undeveloped, and the interesting finds that have been made have resulted largely from two principal developments: (1) The Mining Industry: Gold, in the Labo-Paracale-Mambulao area; and Iron, in the Larap area. (2) Railroad and road building: Especially the new railroad line connecting Tayabas with Camarines Sur; and

various new roadways, especially the new highway connecting the Labo area with Tayabas.)

Tektites.—The region between Labo, Paracale, and Mambulao contains the largest and most spectacular tektites yet found anywhere in the world; and it also contains the largest quantity yet found in any Philippine area except Rizal-Bulacan. The two largest whole unbroken specimens found anywhere came from the area between Batobalani and Paracale, weighing 1,070 and 1,030 grams, respectively; and hundreds of specimens weighing above 200 grams have been found. Some of the most interesting specimens come from the deep gravel beds under the Malaguit and Paracale Rivers, and the largest existing collection was brought up by the dredges of the Coco Grove Mining Co. Their geologic age is certainly Pleistocene; and is probably actually Middle-Pleistocene, like all other Indomalaysianite specimens.

Stone-Age remains.—No true palaeoliths have yet been identified. One good medium-sized Late Neolithic plain-backed stone adze was found near Paracale; and several other Middle and Late Neolithic implements have been reported by prospectors and engineers, from the mining area—although I have not personally examined any except the one from Paracale, and two other rather roughly finished adzes from the Larap iron mining district.

Bronze-Age remains.—A number of interesting pieces of bronze and copper jewelry and ornamental objects (but no identifiable tools, implements, or weapons) were brought up by the Coco Grove dredges. Several of them are identical with Bronze-Age types from Batangas and Rizal-Bulakan.

Iron-Age.—(No true prehistoric Iron-Age site has yet been identified from this province, although certain reported destroyed remains along the new railroad construction suggest Iron-Age possibilities.)

Prehistoric Porcelain Age, and gold-mining.—Most of the reported ceramic remains in this province are around the older mining districts and along the new railroad and roadway constructions. The individual sites are numerous, and they can be grouped roughly into two distinct periods: (*a*) A 12th to 14th century period, containing only monochrome porcelains together with many interesting gold beads and other objects. (*b*) A 15th and 16th century period, containing Ming ceramic wares, native pottery and iron implements.

The older period centers around the Gumaos Peninsula and Mambulao, and many interesting old mine workings and tools have been found there also. A number of Late Sung or Yúan graves containing whole porcelain pieces have been cut into, particularly on the San Mauricio mining property and nearby. The Gumaos area contains the greatest number of ancient workings and tools. At Paracale the remains of the early period have been mostly washed into the bay, but many evidences

have been brought up by the gold dredges Hundreds of most interesting gold beads, of the same types found in certain gold areas of Mindanao and above all at the "Shauger Site" in Samar, have been recovered by the dredges.

The younger pre-Spanish period centers around the Paracale-Labo area; although many graves containing whole pieces of Ming porcelains, etc., have been destroyed along the new railroad line. Near the former offices of the Coco Grove Co., a good-sized midden area was found that doubtless marked the site of a pre-Spanish town, although part of it had already been washed away or destroyed by dredging operations, at the time of my visit. Ming and native ceramic wares were plentiful there, but not a single fragment of Siamese or any other southeastern Asia ware was found. The most interesting finds along the railroad line were between Sipokot and Libmanan—which area was apparently once thickly inhabited, although now mostly covered by second-growth forest. Many graves were cut into and destroyed, and most of the remains scattered or carried away by the workmen. A few of the better porcelain pieces, which I later saw, were collected by the engineers and one foreman. They were all good Chinese pieces of either 14th or 15th century date. The whole region along the middle Bicol River offers interesting possibilities for future exploration—whenever opportunity may be available.

Workers.—Capt. Thomas Leonard, George Kerr, Victor E. Lednicky, H. O. Beyer, J. B. Stapler, Harry L. Barr, Dion Gardner, Donald D. Smythe, John W. Willey, F. Kihlstedt, D. van Eek, and H. G. Hornbostel.

32. *Camarines Sur Province.*—(The region last discussed above, from Sipokot to Libmanan, lies properly in the northwestern part of Camarines Sur—but was visited by me in connection with a trip to Camarines Norte, and has thus been intentionally included there.)

Tekites have been reported from the Caramoan Peninsula, but I have never been able to obtain a specimen found there.

Stone implements.—Jagor found one Neolithic stone axe (or adze) imbedded in a piece of wood in a prehistoric shell heap near Libmanan. (Probably Late Neolithic, though he does not indicate clearly; the year was 1860.) He also mentions stone rat-guards similar to those found in Talim Island (Rizal Province), and in Ifugao, etc. E. Schneider also once told me of a Late Neolithic stone adze or chisel being found near the town of Pili.

Prehistoric Porcelain Age.—A large and carefully gathered collection of ceramic fragments was made in the cultivated area around Lakes Baao and Bato, by Luis Dato, in May, 1932—the best material coming from a place called Manolabak. The bulk of the material is 15th and 16th century Chinese with a considerable proportion of native pottery, including a number of pieces with incised decoration. A few fragments of earlier 14th century or Yuan wares are occasionally mixed

in. It is obvious that most of the material collected is from the midden-heaps of several pre-Spanish villages in this area.

The former collections of the National Museum, Dr. J. P. Bantug, and others, each contained a few Early Ming pieces (mostly 15th century) which had been accidentally excavated in Camarines Sur. Exact localities were seldom recorded.

Recorded in the literature, however, is a still more interesting series of sites. In 1851, while a road was being built at a place called Poro, a short distance beyond Libmanan, an extensive ancient shell-heap was uncovered, and later explored by the priest of Libmanan, an ardent student of natural history. The heap was covered by from 4 to 5 feet of alluvium, and in it and around it were found numerous remains of the early inhabitants. Both animal and human skeletal material, deer antlers, ornamental objects of bronze and brass, and a considerable number of whole ceramic pieces (chiefly of Chinese Sung types) were found. Also found were typical bracelets of red glassy paste, and other ornaments. (This appears to be a culture similar to our early Santa Ana type in Rizal Province.) Jagor himself visited the site in 1860, but had no time to excavate. He obtained one ceramic piece only, a crackled celadon of early Sung date. He learned, however, that equally old or perhaps earlier remains had been found in other shell-heaps near the mouth of the Bigajo River, not far from Libmanan, and that a burial-jar or urn containing remains of a human skeleton had been excavated as early as 1840 at the mouth of the Perlos River, a short distance to the west of the Poro site.

The Poro vicinity should obviously be reëxplored for other remains, when opportunity offers.

Workers.—(As indicated under the preceding various items.)

33. *Albay Province and Catanduanes Island:*

(No modern finds have been reported from Albay Province, although some interesting fossil beds have recently been reported from Catanduanes Island. Both areas are known to have been anciently inhabited, and offer excellent opportunities for archaeological research. Natural tektites have not been reported, but a number of Albay people are known to carry them as charm-stones. They have probably been obtained from Camarines or elsewhere—and small round or oval ones are said to command prices of several pesos each. A few whole porcelain pieces, said to have been accidentally excavated in Albay, formerly existed in the Bantug and other private collections. No specific records are known to me.)

Cagraray Burial Cave.—In the literature of the pre-American period, we have one famous archaeological expedition reported from Albay:

Some time in the period 1879–1881, Drs. J. Montano and Paul Rey, of Paris, accompanied by Juan Alvarez Guerra, then

Spanish governor of Albay Province, explored the great burial cave on the islet of Cagraray, off the Albay east coast. A large amount of skeletal material was obtained, including many artificially deformed skulls as well as considerable quantities of ceramic fragments and other material. Most of the specimens were taken to Paris, but Guerra retained a few of the skulls—which afterwards came with his collection into possession of the National Museum and the University. All of the latter were destroyed during the war, as were also Guerra's crayon drawing of the interior of the cave (showing the location of the various objects as originally found) and his holograph notes on the exploration. Dr. Carl E. Guthe revisited this cave about 1923, and doubtless recorded notes which are with the University of Michigan Collection. (All indications are that the original contents of this cave were very similar to many others later explored in the Visayan Islands.)

Porcelain-Age finds on Catanduanes Island.—In September-October, 1881, Alfred Marche, French scientist, visited a number of caves on Catanduanes—mostly without finding any human remains. However, on October 8, in the cave of Tailan he found five skulls and two probable 15th century blue-and-white porcelain pieces. (These were taken to France, along with his large collection from Marinduque Island, q. v.)

Workers.—(As indicated in the preceding items.) Also Mariano Goyena del Prado.

34. *Sorsogon Province (including also Burias and Ticao Islands):*

(Like Albay, this province has received little or no exploration of its doubtless plentiful archaeological resources, with the notable exception of the jar-burial culture to be hereafter discussed. In 1923 I sailed around the entire coast of Ticao Island, and a part of Burias and located a considerable number of potentially interesting burial-caves. No opportunity has since offered, however, to carry out the actual exploration.)

In the late 1930s Generoso Maceda, of the National Museum, made a brief exploration of an early jar-burial site at Pilar, located on a small bay in the northwestern part of Sorsogon Province. A total of 24 jars were excavated in three different sites, all inside the town limits. Most of them contained bone-fragments, preserved because of the sandy soil; as well as various other articles. Several jars contained glass and paste beads, and some contained iron tools or weapons (spearheads or dagger-blades). There was some evidence of cloth and other articles, long completely disintegrated. The jars themselves are of poorly baked earthenware, and many were crushed or partly disintegrated. (The age of this site, based on other similar jar-burial finds, may be roughly estimated as being in the earlier centuries of the Christian Era—between 300 and 800 A. D.)

Workers.—Generoso Maceda, H. O. Beyer, and others.

C. CENTRAL PHILIPPINES (CHIEFLY THE VISAYAN ISLANDS)

35. *Marinduque Island:*

(Marinduque enjoys the distinction of having been more thoroughly explored archaeologically in pre-American times than any other Philippine island. This is attributable to the energetic Frenchman, Alfred Marche. Little has been done there in later times, despite the great interest of the field—but the greater part of Marche's large collection is still preserved in the Trocadero Museum in Paris.) (Also in the Natural History Museum?)

In April, 1881, Alfred Marche began a systematic exploration of the burial-caves of Marinduque and, although the work was rather unscientifically carried out, collected a great deal of valuable information as well as a considerable collection of actual specimens from the caves.

The first period covered the examination of several burial-caves to the southwest of Boak—the finds consisting chiefly of many rough earthenware and semistoneware burial jars containing more or less disintegrated bones. (This group appears to be essentially the same as that of the Pokanin caves of Mindoro—and is probably a true and rather ancient jar-burial culture, similar to finds at San Narciso, Tayabas; Pilar, Sorsogon; and others from Samar, to be hereafter described.)

The second period covered a much richer group of burial-caves and niches on the Islet of Tres Reyes, near Gasan; but damage by the waves and by cave-ins was considerable. A great number of skulls (mostly deformed), fragments of burial-jars and urns, fragments of small carved wooden coffins, shell bracelets and rings, and several other articles, were found in three separate burial sites. The best cave was located in a very rough rocky area, some 70 meters above sea level.

The third exploration was that of a land burial-site, uncovered in building a road (very like a similar site in Samar). Here two plain greenish yellow-brown or yellow-green glazed burial-jars were found, partly crushed and each covered with a plate or bowl, each containing an earth-filled skull. Inside one of them, a small tall jarlet or pottery bottle was found, containing two interesting gold ornaments made of small pellets welded together (see similar Cebu, Samar, Paracale, and Mindanao types). Also several good-quality red-brown carnelian beads.

The fourth exploration (in May, 1881) was in the vicinity of Santa Cruz, in the northern part of the Island. Here 13 skulls and a number of good jar fragments were obtained from the "Bathala" cave; and a few small jars and dishes, and a number of coffin fragments, from various rock-crevices to the east-southeast of Santa Cruz. At last, in that area, between the 8th and 10th of May, the best find of all was finally made.

The fifth exploration was devoted to this prize of all archaeologists, the fine undisturbed burial-cave known as *Pamine-Taan!* (Located some distance around the mountain from the hamlet of Bonléu, to the east-southeast of Santa Cruz.) Of the actual exploration, Marche says:

"the entrance is a kind of low hole—but, squeezing through the rocks there, I suddenly found myself confronted by a row of coffins placed one on top of the other. At last, here was a burial cave intact! . . . I forbade my assistants to touch the slightest thing—for I reserved to myself the task and the pleasure of opening everything." But, after trying himself to lift one of the heavy hardwood coffins but not succeeding, Marche had his men lift out the coffins of the front row, and carry them one by one outside. "Behind the coffins stood large urns or jars, also containing skeletons." Some of the coffins were decayed, so that they could not be moved without losing part of the skeletal material. However, by dint of much care, the contents of each coffin was kept separate from the others—and they were gradually all removed. The largest coffin was 90 cm. long by 20 cm. wide and 15 cm. high. Many coffins contained an additional skull, usually smaller than the one properly belonging with the skeleton.

Many ornaments were found in the coffins and jars (Marche illustrates 5 types of gold ornaments; 3 types of shell and tortoise-shell bracelets, etc.); but very few beads occurred in this cave.

One curious feature of these burials was the fact that the lower jaw was frequently detached, and placed in the opposite end of the coffin from the cranium. Marche believed that the bones had always been placed in the coffins and jars after they had already been cleaned and dried—perhaps some time after a preliminary burial.

Numerous small porcelain objects were found among the bones in the coffins—including small plates, saucers, small vases and flasks (some of stoneware), etc.—and, rather curiously, no two seemed to be alike, but all differed in form, design, size, or material.

Most of the large burial urns, back of the coffins, had the mouths closed with a whole or broken plate, serving as a cover. Several jars were broken, but one very fine specimen was in perfect condition—being glazed over the whole body except the base, and decorated with two fire-spitting dragons with four claws on each foot. Other jars were mostly plain, and either brown or black-glazed. The contents were similar to those of the coffins, but usually of better quality. Each jar usually contained from two to four gold ornaments, but beads were scarce. Two copper or bronze earrings and one finger-ring were found. One iron dagger-blade or knife, one small axe (both rusted to the point of disintegration), and a hardwood spearhead, were also found.

Some of the coffins were empty,—but altogether some 40 skulls and about a dozen complete skeletons were obtained from this cave. Most of the skulls were artificially deformed. Three full days were spent in the exploration.

A sixth exploration was made at the cave of Macayan. Here only five deformed skulls, and numerous pieces of broken jars, etc., were found, as the place had been invaded by treasure-hunters and everything was broken up or looted. Marche also learned here of other caves that had been completely looted, but did not visit them.

A seventh exploration was carried out near San Andrés, on the north coast, and near the barrio of Balinakan. On May 20th seven caves, and on May 21st five caves, were visited, but only broken jars and fragments and a few scattered bones were found. Later, several other places were visited without any important finds—in the neighborhood of Boak—around the end of May and beginning of June.

An eighth important exploration was carried out, from the 5th to the 12th of June. On a small hill near the shore, in the neighborhood of Gasan, some workmen building a new road had uncovered several burial jars at a depth of about 5 to 6 feet. Five jars were broken up by the workmen before Marche's arrival. As the prospects seemed good, he planned a systematic excavation, to the right of the road, which lasted for seven days. On the third day two earthen jars were found, each containing a skull, a small jarlet or vase, and some beads. On the fifth day, one glazed dragon-jar (with 4 claws) was found. On the sixth day a jar containing two skulls (one being that of a child) was found imbedded in the roots of a tree; containing also 4 bronze rings, a large quantity of small beads, and two gold ornaments in the form of stars. On the seventh and last day another dragon-jar of the same type as those dug previously was also found wedged between tree roots. (This jar and some other Marinduque specimens were later deposited by Marche in the Museum of Madrid.)

After an abortive trip to the eastern part of the Island in the middle of June, Marche, accompanied by his friend Berdote, secured a boat and made a sailing and rowing trip clear around the Island. Many looted caves, crevices, and rock-shelters were found to contain scattered bones and ceramic fragments, but it was not until June 25th that the first real find was made. On this date, one kilometer inland from Castillo de Figui, a place where many buried plates, jars, etc., had been found, was visited, Marche obtaining three of the plates, and also finding some carved wooden images (very like Ifugao or Igorot workmanship) in a nearby cave.

On June 27th, at Balakassa, ten skulls, several good pieces of burial-jars, and (in the cave of Lugukan) a very large broken plate, were obtained. On the 30th they arrived again

near Bonleu, only one kilometer from the famous cave of Pamine-Taan. Here Marche made some additional searches and diggings, finding, among other things, under a layer of guano, two carved coffin lids and bodies, many ceramic fragments, etc. On one of the coffin lids a large iguana was carved, with denticulated tail; while on the other lid were two iguanas with backs toward one another, and with their heads passing beyond the cover and serving as handles to carry the coffin. (Similar specimens were found in northeastern Panay by Merton L. Miller and Luther Parker, in 1912.)

Finally reaching Santa Cruz on July 3rd, with a big storm brewing, the return was made to Boak overland on the 4th. Packing his numerous collections carefully, Marche left for Manila on July 12th, and later back to France, with everything intact. (Thus concluding the most successful Philippine archaeological expedition recorded from Spanish times.)

Other Marinduque finds.—Around 1900–1901 Dr. T. H. Pardo de Tavera obtained several interesting whole ceramic pieces, all said to have come from burial-caves or niches in Marinduque. I examined these (and others in his collection), and photographed many of them, about 1923–1924. Especially interesting were two good Sawankhalok celadons, and a large Yuan or Early Ming celadon dish about 14 inches in diameter. All the Marinduque pieces were between the 13th and 15th centuries, in date.

University students from Marinduque have furnished me with interesting notes on several caves there, said to still contain bones and ceramic fragments. Doubtless other profitable explorations can still be carried out in so rich a field as Marche's work indicates. (No Stone-Age remains or tektites have yet been reported from this Island.)

Workers.—(As indicated in the preceding items.) Also Eduardo Palma.

36. *Mindoro and the Lubang Islands:*

(No true Stone-Age remains or tektites yet reported. In March, 1929, what appears to be an early Iron-Age site was uncovered when a new road was being built from the beach to the town of Calapan. The find was made about a half kilometer along the road from the usual landing place, and consisted of several interesting native pottery vessels, some strange looking gold ornaments, and other objects. One whole small pottery vessel was brought to me by Leovigildo V. Monasterial—but he feared that all the others, and especially the gold ornaments, had been carried away by the workmen or destroyed. The piece brought to meis definitely related to our Early Iron-Age wares—particularly such as are found in the Visayan Islands, etc. (See decorated angle-pot from northern Negros, etc.)

In 1904–1905 Dr. Fletcher Gardner explored some very interesting caves at Pokanin, and made a considerable collection of

skeletal material and jar fragments there for the Philippine Museum. The principal Pokanin cave is high in a cliff-side, between Bulalacao and Mansalay, in the southeastern part of the Island. A large number of skulls and other skeletal remains, together with many large broken burial jars, were found in this cave—although the material was already badly mixed up and disturbed when first found. No porcelain fragments were seen (although there were a number of native potsherds); and it appears that this site is one of the older types of jar-burial—similar to Pilar, Sorsogon; San Narciso, Tayabas, two of Marche's sites near Gasan in Marinduque, Guthe's Samar site, etc. (This estimate is borne out by Gardner's photographs, and by the jar-fragments formerly in the Philippine Museum; etc.)

A number of celadon dishes, mostly of Yuan or Early Ming types, have from time to time been brought to Manila by mining men, hunters, and others, who obtained them from Mindoro natives, chiefly from the west coast (and two or three that I have seen from the Lubang Islands). They all seem to have come from accidental excavations in fields, or in house-building, etc., and no definite productive burial-sites have been reported.

The only spot where definite midden and cave remains of this type have been explored is on Ilin Island, a little distance to the southwest of San José. Several people have made explorations there, and the best material was doubtless taken away long ago; but I have a fair-sized collection of midden material made in two places there, by G. M. Goodall, in the middle 1930s. Also a much smaller lot, collected from a cave in the center of the island by Capt. E. S. Ross and Col. J. L. Hitchings in 1946. The porcelain fragments are all 14th or 15th century; but they are mixed also with many native potsherds, pieces of human and animal bone, and a few fragments of disintegrated iron tools and weapons, which may or may not be contemporary. (The site probably belongs to the same culture as the Calatagan Peninsula area of Batangas Province, and many other spots in the islands to the east and southeast of Mindoro.)

The pagan Mangyans of southern Mindoro are still using one of the two syllabaries of Indian origin that yet survive in the Philippines, inscribing it chiefly on cylinders or tablets of bamboo. It is probable that other interesting culture elements have survived along with the syllabary—which lends additional interest to the extensive study of Mangyan culture, writing, and literature now being carried on by Harold C. Conklin, in connection with this Institute.

Workers.—(As indicated under the preceding various items.) Also Merton L. Miller, Victor E. Lednicky, E. de Villa, Paul Schebesta, and others. [For additional data on Mindoro, see Addendum.]

37. *Banton Island (part of Romblon Province):*

In the spring of 1937 an interesting undisturbed burial-cave, not previously known to the people, was discovered in the sitio of Guyangan (about 1 kilometer from the town of Jones). The cave was almost completely looted by the Jones citizens in a wild search for buried treasure—graphically described by C. Faigao in the Philippines Free Press, issue for July 31, 1937.

The cave is located about 32 meters above sea-level, in the side of a high cliff, and could only be reached by a descent of some 10 to 12 meters from the cliff top. Entrance was gained through the aid of a rope tied to a tree on the cliff top. Faigao states that some 40 wooden coffins, in various states of preservation, were found. The number of whole porcelain dishes, small jars, flasks, saucers, and other pieces obtained was considerable, and 12 gold ornaments were also found (some of the latter by excavating a portion of the deposit on the cave floor). Some of the dried and better preserved coffins were found to be ornamented by a crocodile or lizard design, others showed only the head of a crocodile, while one had the figure of a kneeling man. Some of the smaller coffins contained only two skulls, while in others the bones appear to have been originally wrapped in something resembling abaka cloth. (All of this shows close resemblance to Marche's interesting Pamine-Taan cave in Marinduque.)

E. D. Hester later obtained 10 of the Banton pieces for his collection. They are all Chinese wares of the 14th and early 15th centuries. No Sawankhalok or other southeastern Asia pieces appear in the lot. None of the gold ornaments have been seen by us, and it is to be feared that most of them were melted up and sold by their finders.

No other archaeological finds have been reported from Banton.

Workers.—(As in the foregoing.) Also Gabriel F. Fabella.

38. *Romblon Island (part of Romblon Province):*

(Romblon is the most thickly inhabited island of the group of the same name, and numerous casual finds of interesting specimens are reported among the natives there, but unfortunately very few have survived or been examined by a qualified observer. Certain caves have been reported to contain jars, dishes, and jewelry, as well as bones but so far I have an accurate report concerning only two of them—see the following.)

In 1929 a former assistant of mine, Tomás Maglaya, while on a hunting trip in the interior of Romblon, found an interesting cave in the barrio of Lio, and another one nearby (probably in the same barrio). Maglaya states that both caves are full of porcelain and stoneware fragments, as well as many scattered skulls and other skeletal remains. Due to the nature of his trip, he was able to carry away with him only two

jar-fragments, both of which he later brought to me in Manila. They are both good-sized pieces of 14th century Early Ming dragon-jars of the best types, with designs cut in high relief and the dragons having four claws on each foot. One is a pure yellow-brown, while the other is greenish-brown glazed.

Workers.—(As in the foregoing.)

89. *Tablas Island* (*Romblon Province*):

(This island is the largest of the Romblon Group, but is rather thinly inhabited. It has been the scene of several interesting archaeological finds, which will be listed separately below.)

In February, 1923, Edward H. Taylor, while collecting herpetological specimens for the Bureau of Science, came across some interesting archaeological remains and made a small but good collection for my benefit. On a headland near Odiongan. he found a spot where a cave had probably formerly existed but later caved in, leaving many skeletal remains, ceramic fragments, and other objects scattered among the rocks. Taylor counted 30 skulls, more or less whole; a large quantity of ceramic fragments; a few pieces of much-decayed wooden coffins; some strange ornaments; and a few pieces of disintegrated iron tools and weapons. He believes that many other specimens were covered by the fallen rocks, some of which are of large size.

He brought back for my collection two good skulls (one artificially deformed), 2 iron weapons, 72 ceramic pieces in large fragments (of which eight are nearly whole), and a few smaller potsherds. For himself he kept only a curious amulet of copper or bronze (of which he gave me a drawing), with a small ring at the top, rather similar to some specimens from site 13, Rizal Province. The ceramic wares, in addition to fragments of dragon-jars and common red pottery, consist chiefly of 15th and 16th century Chinese blue-and-white deep dishes, plates, saucers, small jarlets, bowls, etc. (It is probable that many other objects could be obtained at this site, especially by excavating under the larger fallen rocks, etc.)

Another site, further inland on a small farm near Odiongan, was brought to my attention by a former student of the University of the Philippines. This appears to be a village midden, possibly accompanied by early land burials. Some interesting fragments of native pottery, bearing curious incised designs, were brought in, but many other objects are reported to have been found there, which I have not seen.

Subsequent finds of skulls, jar-fragments, and other material, have been reported from three different localities on the eastern side of Tablas; but I have not yet been able to examine any of the material, some of which I fear was destroyed during the recent war.

Workers.—(As in the foregoing.) For further data on Tablas see Addendum.

40. *Sibuyan Island (Romblon Province):*

(Now the most heavily forested and mountainous island of the Romblon Group, but once apparently much more thickly inhabited. Ancient remains have been found in several places, on which I have the following notes:)

An American mining engineer, who formerly lived several years on this island, states that he had from time to time run across a number of caves containing celadon dishes, pieces of wooden coffins, beads and fragments of glass bracelets, and large quantities of bones, jar fragments, and other sherds of ceramic material. He usually did not disturb them, due to the fear and respect with which the local natives regard such places, although he had a few times taken some of the objects to his house, whence they had either been carried away by visitors or been lost, or sometimes been returned by his servants to the cave again.

On April 21, 1930, another mining man, Mr. W. G. Carpenter, brought me a few ceramic fragments that he had found on the west bank and near the mouth of the small river which comes out at Magallanes barrio. Two are fragments of black-glazed Early or Middle Ming jars, but the other sherds are mostly of 19th century or modern wares of the late Spanish period.

(No Stone-Age or Early Iron-Age sites have been located.)

Workers.—(As in the foregoing.)

41. *Masbate Island (now also a province):*

(Due to the extent of ancient and modern mining activities, with resulting frequent visits of geologists and explorers—and to the extra large number of Europeans and Americans living in the Island from time to time—it is not surprising that Masbate shows a considerable number of archaeological finds. Actually, however, very few of the numerous accidental finds have been followed up and systematically explored; and this Island remains one of our potentially most interesting archaeological fields, awaiting proper systematic exploration of the entire terrain. A few of the more important reported finds are listed below:)

Warren D. Smith's finds at Batuñgan Cave.—The Batuñgan Caves (mistakenly named "Batwaan" in published account), in northwestern Masbate, were described in the Philippine Journal of Science [*19* No. 2 (August, 1921) 233–241, plus 5 plates], by Warren D. Smith. One of the four caves examined, in a huge limestone massif, is undoubtedly a burial cave containing some 44 skulls, a large quantity of other loose bones, a narrow wooden coffin or skull-box with carved crocodile-head handles, a smaller and much disintegrated head-box, and two Neolithic stone implements. The largest of the caves is described as a "Living-cave," and contained remnants of fireplaces, pottery stoves, and numerous fragments of potsherds, some with incised decoration. Deer-teeth and teeth and bones

of other edible animals, shells of edible clams, etc., were also numerous. A large piece of a shell bracelet was also found.

The two stone implements are very interesting. One is an Early Neolithic adze, probably repolished in later times; while the other is a Middle or Late Neolithic chisel of felsite or andesite, well patinated. Three other similar implements had been taken from these same caves by Mr. Wilson, an American lawyer owning a ranch in the neighborhood, prior to Smith's visit. For details, see Addendum.

Many of the skulls in the burial cave were artificially deformed. Smith took only two, but most of the remainder were removed in 1923 by Dr. Carl E. Guthe, and added to the Michigan collection. All existing evidence indicates that the burial cave is Porcelain Age, probably Yuan or Early Ming, in date.

Bernhard Radtke's early and later finds.—As early as 1912 B. M. Radtke, a German owning a large cattle-ranch in northern Masbate, reported to the Bureau of Science his finds of burial-caves, burial niches, and land-burials along the coastal region of that area. He brought to Manila a very artistically small carved head-box, several jars, porcelain pieces, and other objects, found in some of these burials. His collection was not acquired by the Bureau, owing to the prohibitive price demanded. (Some of the specimens were later acquired by Dr. Carl Guthe, and went to the Michigan museum.)

In September, 1928, Mr. Radtke brought another interesting collection to Manila, from the same general area, and later turned it over to me for a relatively reasonable price. All of these specimens were obtained on or near the Radtke Cattle Ranch, in the sitio of Luka, Colorado barrio, Aroroy municipality, at the northern extremity of the Island. The principal objects in the second collection were: Three whole Ming plates, all 15th century; two broken dragon jars, probably also 15th century; one whole tall dragon jar of a peculiar type that is probably Yuan or earlier; 10 good pieces of broken celadon dishes and small jars; one whole clay pot of native ware; and 23 filed, reddened, and originally inlaid teeth, of which only one still has the gold peg in place. Most of the celadons came from a (Yuan?) land-burial site, the whole dragon-jar from a small burial-niche accidentally uncovered, and the remaining material all from burial caves and niches along the coast. (No Stone-Age material or tektites were ever found, although I asked him particularly to look for them.) Celadon-producing midden-sites still exist on his ranch, particularly in the area where the gardens are located.

Dimasalang burial cave.—In January, 1930, Jaime Echevarria brought to Manila a number of interesting small objects and porcelain fragments, all of which had been obtained from a small burial-cave near Dimasalang. He stated that much similar material could be obtained in the vicinity, and that he

had brought in a few samples only. The lot consists of nine ceramic pieces and fragments, one whole shell bracelet, five broken shell bracelets of three different types, a broken blue-glass bead, and a mammalian tooth with carry-polish indicating possible use as a charm or ornament. The specimens seem to all date from the 14th to the beginning of the 16th century—the porcelain showing both Chinese and Sawankhalok types—but two pieces may indicate a still earlier burial in the back of the cave. (Further exploration of the Dimasalang area is unquestionably advisable.)

Cooke burial-jar site.—Another Masbate Porcelain-Age site of much interest is that brought to my attention about 1936 by Mr. C. J. Cooke. It is located between 7 and 8 kilometers south of Aroroy, or about half-way along the trail from the town to the Cooke Ranch. It is accessible only on foot or by horseback.

The site consists of a sizable dome-shaped hill, on one slope of which a number of interesting jar-burials were excavated by the farmer now cultivating the spot. Having learned of the finds, Mr. Cooke assisted this man in digging out one of the jars and examining its contents. Several beads and glass bracelet fragments of unusually interesting types were brought by him to me in Manila. From his description it seems likely that a very sizable burial ground is located in this area, and that many jar-burials could be found around the hillside by a systematic search. He thinks that perhaps a dozen jars had already been excavated by the farmer, who usually broke them up and scattered the contents in true treasure-hunt style. The material brought in seems, rather curiously, to be Iron Age rather than Porcelain Age in type, but, in the absence of fragments of the jars and other pottery from the site, no certain dating can yet be attempted.

Finds in and around the old mines at Aroroy.—During the early decades of American mining exploration in Masbate, many interesting finds of ancient workings, old tools, and associated ceramic wares and other objects, were made. The late Col. H. B. McCoy, and Messrs. Herbert, Schwab, Edelmeier, Wilson, Carpenter, and others, as well as Dr. Warren D. Smith, often told me of such finds, and their usual opinion was that the oldest workings were Chinese in origin. However, later researches conducted by Mr. Herbert and others, at my suggestion, clearly indicated that many of the older workings were made by Hindu and Javanese methods ("quick-lime process") rather than by Chinese ("gunpowder method"). This tends to confirm our early historical records, which imply extensive gold-mining in the Philippines by Indians and Javanese during the days of Sri-Vishaya and Madjapahit.

A few small lots of ceramic fragments and old mining tools from this area were brought in occasionally for my collection. The most recent and best of these was delivered in December, 1939, by H. D. Weidman, of the Masbate Consolidated Mining

Co. The lot consists chiefly of porcelain and pottery fragments gathered by himself, and assisted by H. A. Mann and A. Kelly, from a midden site on and around the old surface workings of the Panique Mine. A sizable new area was being opened up there, and a number of ancient workings were being uncovered in the process. Most of the ceramic material appears to have come from an old midden deposit along the crest of the ridge where the work was being done.

The specimens are almost entirely late 15th and early 16th century Chinese wares, apparently coming to an end about the time of the Spanish Occupation. Only one Sawankhalok fragment appears, being part of the cover of an early 16th century black-and-white small round vase or box of the usual type. A few fragments of Chinese stoneware jars occur, but most of the common pottery is doubtless of native origin.

Future possibilities.—From the above data it is apparent that Masbate Island is rich in archaeological deposits, and that properly conducted systematic work there would likely be very productive. The mining industry there has largely been closed down for the past six years, and the countryside is rapidly growing up to weeds and jungle again. Should it be reopened, as a part of the reconstruction program, an effort should be made to station a capable archaeologist there.

Workers.—(As indicated under the foregoing various items.) Also Dr. A. C. Skerl, Mark Hubbard, and others. [For further Masbate data, see Addendum.]

42. *Samar Island:*

(Considering the richness of the finds made in widely separated parts of this little explored island, it seems likely to prove one of the best fields for future work. More than a dozen important finds have been made in Samar in the past, and it will be possible here to give only a brief and inadequate description of them. No particular arrangement is attempted, except by general subject.)

Tektites and Stone-Age remains.—Early in 1931 a weather observer in Samar found a single spheroidal tektite in the barrio of Lawaan, Wright municipality, and sent it to Fr. Miguel Selga in Manila. It is still uncertain whether this was a true natural specimen, or whether it reached Lawaan by human transport (as a charm-stone or curiosity).

Dr. Carl Guthe found one small stone axe or adze in Samar, but I do not have the data as to locality. The late Joseph Motok, of Catbalogan, also told me in 1924 of seeing several Neolithic stone adzes which were preserved as charms or magic stones ("lightning tongues") among the semipagan hill people in the interior of the Island. He was not able to obtain a specimen at that time.

In the 1860s Feodor Jagor saw interesting fossil beds near Basey, and at two other Samar localities, but did not have time to examine them in detail.

Jar-burial sites of the early type.—On August 13, 1921, Mr. Ralph S. Frush, an engineer in charge of work on the eastward extension of the Catbalogan-Wright road, came across a most interesting ancient jar-burial site of the same general type as those previously described from Pilar, Sorsogon, and San Narciso, Tayabas. The site is located in the barrio of Motiong, Wright municipality—most of the jars being found in a clay soil, about a meter below the surface, near the foot of a steep mound or small round hill located only about 20 meters from the seashore. A small creek runs into the sea near the foot of the mound.

More than sixty burial jars were actually excavated in this locality, and it is probable that many more still exist there outside the road-area. Most of the jars contained only much disintegrated bones, but a few are said to have contained some beads and a few gold ornaments, which were quickly sequestered by the laborers who dug them out. Two iron knives shaped like *kampilan* were also found, but they were so completely rusted that they fell to pieces when lifted. All of the jars seemed to be of thick unglazed earthenware, quite similar to those found at Pilar and San Narciso.

Mr. Frush stated that many similar jars, as well as some glazed ware and celadon pieces, had been excavated previously in the barrio of Lawaan, and that a number of gold ornaments, some of which he had seen, were found with the Lawaan specimens. It seems evident that further systematic work would be profitable, both in Motiong and Lawaan. (If the Lawaan tektite is really a charmstone, it may possibly have come from one of these graves.)

In February, 1923, Dr. Carl E. Guthe excavated part of another burial site, also accidentally discovered in road-building, near the barrio of Egid (Igid?), a few miles north of Catbalogan. The road-contractor had previously dug out a number of jar-burials, in which the jars had been covered with flat stones grooved to fit over the jar rim—exactly as Galang found at San Narciso, Tayabas. In addition to finding a grooved stone cover and a mass of confused skeletal materials in an area disturbed by the contractor, Doctor Guthe excavated five additional jar-burials (containing what appeared to be remains of children) and five adult skeletons buried at length. One of the adult skeletons had the remains of an iron dagger in the right hand, while in another case a bent dagger was lying on the chest. The heads were oriented towards the east. In all of the jar-burials the bones were badly disintegrated, but each contained a number of small colored beads (white, red. yellow, orange, and blue) and a hard white deposit in the bottom, the character of which was not identified. The jars themselves were of the usual thick coarse earthenware common to true jar-burial sites.

Two small midden sites were found in the vicinity. One, consisting chiefly of a shell heap (containing 17 edible va-

rieties in which were mixed native pottery fragments, remains of fires, etc., but no porcelain, could be contemporary with the jar-burials. The other, some little distance away and containing Chinese porcelain fragments, seems to be of a much later date.

(About 1919 or 1920 Herbert G. Schenck, then a young geologist connected with the Bureau of Science, found an interesting skull and some other mixed skeletal remains washing out of an old sand bed, on the Samar coast in this vicinity. The evidence strongly points towards their having come from some such deposit as that excavated by Doctor Guthe. Unfortunately, both specimens and accompanying notes were destroyed during the war, and a recheck is no longer possible.)

Oldest Porcelain-Age burial-cave finds.—In 1860 Feodor Jagor, making his headquarters at Basey, explored a large number of burial-caves and other caves near the eastern entrance of the San Juanico Strait. At Nipa-nipa, a few miles from Basey, he found numerous broken coffins, several skulls, and many potsherds both of porcelain and pottery. Three shapes of coffins were seen.

At Giwan he secured four good porcelain pieces and a gold ring of the hollow-tube type—all said to have been found in a nearby cave. At Catubig he saw several ancient gold ornaments (from a cave in the vicinity) which the people had already converted into modern adornments.

At Laoang one cave is famous on account of the gigantic flattened and deformed skulls found in it.

Doctor Guthe's cave-excavation on the islet of Suluan.—A single cave is located on a rocky islet connected to Suluan by a tidal flat, off the southern point of Samar. The cave is low and small, with two openings, and is probably washed to some extent by waves in the more violent storms. Doctor Guthe's party spent five days in screening the earth within the cave. There was a quantity of skeletal material, of which the more perfect specimens were saved. The following is a list of the specimens obtained from this cave: 22 green, 4 white, and 1 grey, ceramic fragments; 43 blue and white and 3 black and white, ceramic fragments; 11 fragments of dark-glazed jars; 1 fragment of native pottery; 1 specimen each of gold, copper, lead, and iron; 1 piece glass (a bracelet fragment?); 4 beads; 5 shell specimens; 14 skeletal specimens; and 5 miscellaneous—or 118 specimens in all.

Early Porcelain Age: The Shauger Sites.—The greater part of the former extensive Shauger Collection from Samar came from a single huge burial ground, dating from the Sung-Yuan period, which was slowly being cut into by a river on Shauger's ranch-located a considerable distance inland from Wright in the general direction of Taft. The general interest of this site has been greatly enhanced by the high quality and perfect state of preservation of the specimens—a condition which has

been greatly contributed to by the sandy and noncorrosive nature of the soil in the locality. However, there are other smaller burial sites of a similar nature in that vicinity, as Governor Shauger informed me while still living, and about 25 per cent of his collection came from such other sites—some of which specimens are not as high in quality as those from the original site. The dissemination of this collection after Shauger's death (about 1936) is a great loss to Philippine archaeology.

Several of the best porcelain pieces and a good selection of gold ornaments were brought to Manila in 1929–1930 by Governor Shauger who kindly allowed me to have them photographed. Unfortunately these photographs are all that remain of a very wonderful collection—one of the best ever made in the Philippines.

The porcelains, which constitute the bulk of the collection, are remarkable merely for their quality and fine state of preservation—since we have similar specimens from a number of other Philippine sites, and no unique pieces appear in the Shauger lot. The case of the gold ornaments, however, is very different. The Governor had accumulated between two and three hundred pieces of old Philippine gold work, many of which were entirely unique until some of the types began to turn up in dredging operations in Paracale and the Zamboanga Peninsula. More than 25 types of gold beads, varying from tiny specimens a millimeter in diameter up to heavy tubes nearly 10 centimenters in length, covered with arrangements of ornamental pellets of various sizes, were found, as well as a number of rings, ear-ornaments, etc. (The types can only be shown properly by photographs or drawings.) The date of the bulk of the Shauger material is probably not later than the 12th and 13th centuries, A. D.

Later Porcelain Age; The Hartendorp Collection from eastern Samar.—In March, 1919, A. V. H. Hartendorp explored three cave-sites near the town of Borongan, on the east coast. The three sites are known to the local people as Tominobo, Kalikó'an, and Isla de Ando, respectively—and the latter site was already reported to Jagor in 1860. They all lie relatively near together, at a point some seven or eight kilometers to the northeast of Borongan town.

The Tominobo cave contained the least numerous remains, and all the ceramic material is of probable 14th or 15th century date.

The Pananañgátan cave at Kalibó'an barrio proved the most interesting of all—containing numerous remains of a variegated character. Many fine quality but broken Sawankhalok and Chinese porcelain pieces were found, as well as considerable skeletal material, loose teeth filed and artificially blackened, a number of interesting shell ornaments, some rust cakes that had once been iron from weapons, and other objects. Among the decayed remains of a wooden coffin, two small

whole porcelain jarlets, one whole shell bracelet of an early type and several other ornaments and small objects, were found, together with a group of much decayed bones and skull fragments. One of the small jarlets strongly resembles the Kalong wares of northern Siam, and it had evidently been used as a lime container for betel chewing. A few of the celadon fragments in this cave are evidently Lungchuan productions of the late Sung period, but a majority of the material is Yuan or early Ming in date. Many good dragon-jar fragments of the earlier Ming types were found, and many pieces of shell bracelets and other ornaments. It seems obvious that there are two periods of burial in this cave (one Late Sung and Other Early Ming), and the two distinctive types of bracelets found tend to confirm this view. The shell bracelets with rectangular cross-section are found only with Early Ming material, as are also certain types of shell beads and belt rings. The percentage of Sawankhalok wares mixed with the Early Ming ceramics runs up to 40 or more, in these east Samar caves. However, only two good Sukhotai specimens have been identified in the lot, and three fragments of the special "red-bottomed" type of supposed Indo China ware. This is of decided chronological significance.

The small island known as "Isla de Ando" contains not merely one but a considerable group of small caves, niches, and rock-shelters, located some distance apart. Hartendorp had time to explore only nine of them, finding ceramic fragments and some human remains in practically all. Fragments of dragon-jars and of 15th and early 16th century porcelains including some interesting early three-color wares, are the commonest. Ando IV produced one whole jarlet, and Ando II three excellent but broken Sawankhalok celadon dishes, as well as an extra-large "lion"-ear from a big Early Ming jar. Ando III had several typical Sukhotai deep black-and-white fish dishes of definite middle 14th century date; while Ando V and VI contained only native pottery and some skeletal material, but no porcelain fragments at all.

A number of the more nearly complete skulls were collected by Hartendorp, and most of them clearly show artificial deformation. Many of the teeth are filed and blackened. Due to transportation difficulties chiefly, only a small part of the total remains in these caves was collected, and they all merit additional work in the future, particularly with excavation of dirt-filled portions. Three quite definite periods of use appear: (1) Middle or Late Sung; (2) 14th and early 15th century, with presence of Sukhotai and Sawankhalok wares; and (3) Late 15th and early 16th century, with absence of Siamese wars very notable.

Other Later Porcelain-Age finds.—A number of interestng pre-Spanish and early Spanish period ceramic pieces were gathered from various parts of Samar by Joseph Motok, first for Dean C. Worcester and later for Dr. Carl Guthe. I examined

some of this material in 1923–1924 and found it to consist chiefly of stoneware jars, celadon dishes of varying size and quality, and a considerable number of shell bracelets, beads, and other small articles—mostly from accidental finds inland, plus considerable broken material from caves along the coast. Collecting notes were not always very accurate or reliable. Nevertheless, Motok compiled many interesting and informative notes concerning the natural history and archaeology of Samar.

The late F. W. McCaw in 1928 gave me a small porcelain vial, of probable 15th or early 16th century date, that he had found about 1914 in a cave on a small island near Catbalogan. At that time there were many porcelain and jar fragments in the cave, as well as human bones, pieces of disintegrated wooden coffins, etc. It is probable that Doctor Guthe later removed most of this material, but the site should be reëxamined systematically.

In the 1930s Pedro Menguito, one of my most energetic general collectors, made a trip through western Samar and obtained a number of good pre-Spanish porcelain pieces (mostly damaged to some degree), chiefly from accidental finds by farmers and others, and mostly without any definite record of specific locality. No new sites were located.

The most recent Samar finds were made chiefly in the general neighborhood of the Elizalde iron mines in the southeastern part of the Island. The first specimens from this locality were collected by Dean F. Frasche, of the Philippine Bureau of Mines, who obtained a number of interesting skulls (mostly deformed) from a cave and several whole celadon dishes and other pieces from accidentally excavated land-burials in the vicinity. In December, 1938, Mr. Claude Russell brought me a basketful of large and small porcelain fragments, broken shell bracelets, etc., chiefly from the same cave where the Frasche skulls were found. This material consists of about one-third Sukhotai and other early Siamese wares, one-third Chinese monochromes, and one-third Chinese and Indo-China blue-and-whites—all dating probably between the late 13th and middle 15th centuries. The probable Indo-China blue-and-whites belong to the curious red-bottomed group; while the Siamese wares are mostly of the very early Sukhotai black-and-white type with reddish bodyware. There is also a unique celadon dish that seems pretty definitely to have a Sukhotai body, and one black-glazed small jar that may be either Kalong or early Chalian. Four types of shell bracelet occur, one of which is of the rare wide type with parallel fluting—hitherto known only from Cebú and one or two other Central Visayan localities. One other type is, so far, unique to this site.

On the whole, the Frasche-Russell Site is one of the most interesting yet found in Samar, and certainly merits systematic exploration. Other interesting remains, as yet unexplored,

are also said to be plentiful in the vicinity and to merit detailed investigation.

Workers.—(As indicated under the foregoing various items.) Also Cecilio I. Lim, José L. Lagrimas, and Hugo Fresto. [For additional Samar data, see Addendum.]

43. *Leyte Island and Province (including Panon, Biliran, and Maripipi Islands):*

(No systematic archaeological work has ever been done in the thickly inhabited Leyte Island; although, theoretically, it should be one of our richest hunting grounds. However, due to the extensive cultivation, many accidental finds have been made from time to time. No tektites or palaeoliths have yet been reported.

Late Stone-Age finds.—In December, 1935, Mr. Jesus I. de Veyra donated to the University collection two very interesting Middle or Late Neolithic stone adzes which had been found in the early part of the same year in the edge of a bank on the beach being washed away by the sea at Kalubian. He stated that the local people speak of having found other similar specimens in this vicinity in the past, and they call them '*tangó han linti*', or "lightning teeth." (These are the first true prehistoric stone-implements reported from the Island, and the site should certainly be investigated further.)

Early Porcelain-Age finds at Ormoc.—In May, 1937, Mr. Manuel Abello, Jr., assistant manager of the Ormoc Sugar Co., informed me of some very interesting finds of unique gold ornaments and ceramic pieces on certain sugar lands in the vicinity of Ormoc; and later, in June he kindly sent me photographs of part of the gold collection and of a clay pot in which they had been found. A peculiar gold image is said to be in the hands of another person, and could not be included in the photograph.

Of the six pictured gold ornaments, three can at once be identified as being quite similar to old Javanese gold work of the pre-Madjapahit period (say 12th century or earlier), and one specimen is practically identical with the Perkins gold rings found also buried in a pot in San Felipe Neri, Rizal Province. One of these pieces (resembling a snail, with a small tube through one end) is very similar to a Shauger 12th century bead-pendant from Samar. Two of the other pictured specimens are similar to the thin Iron-Age gold work of Site A in Rizal Province, and certain mixed Late Iron-Age and Early Porcelain-Age thin gold bands from Cebú and Marinduque. The last pictured specimen is a heavy gold chain, with a hook and ring for wearing around the neck, quite similar to certain old specimens from the Batanes Islands and from central Luzon.

Practically all of the gold ornaments and whole porcelain pieces found in this group of sites passed into the hands of well-to-do people connected with the Ormoc Sugar Central, and

they do not wish to part with them. How many specimens survived the war period is not known.

Other Ormoc finds.—On March 23, 1929, T. M. Suficiencia accidentally excavated two whole ceramic specimens on a small farm near Ormoc. He presented them in 1930 to former Governor-General Dwight W. Davis, who donated them to my collection in 1931. One specimen is a very interesting small Sawankhalok jarlet or narrow-necked bottle with a typical treacle-brown glaze—almost certainly 14th century in date. The other piece is a small but heavy brown-glazed stoneware jar—probably Chinese ware of the early 15th century. (This area should be further investigated.)

In late December, 1932, an American teacher, Mr. Manley Sharpe, found in a cave near Ormoc a small unique ceramic specimen, which was afterwards brought to me by Harold Jacobs. This specimen is a unique piece of native pottery that seems to be a funerary representation of an ornamental bolo-handle or scabbard-end, but of no utilitarian value in itself. The cave, which was examined by both Jacobs and Sharpe, is said to contain many porcelain and pottery fragments, as well as bones and other objects; but, not having any means of transportation, they took only a few small or unusual specimens that could be easily carried. (If this cave can be again located, it should be thoroughly explored.)

Miscellaneous Porcelain-Age collections from Leyte.—Both Dean C. Worcester and Dr. Carl Guthe did considerable miscellaneous porcelain collecting in Leyte and Samar, in addition to their main field of work in the Cebú-Bohol-Siquijor group. In his final published report ("Distribution of Sites Visited", etc.), Doctor Guthe lists 2 caves and 2 land-burials explored in Leyte, and 12 caves, 3 burial-grounds, and 2 individual land-burials explored in Samar. None of the locations of Leyte sites are given, however; although there is doubtless a complete record with the collections in the Michigan University Museum. It is also probable that all identifiable Worcester sites are recorded there, but none of the data are available in Manila at this time.

Pedro Menguito's collecting.—This collector, employed by me for a considerable period, spent some time in Leyte in the latter part of 1932 and obtained a number of good porcelain and stoneware pieces from accidental finds, but was able to locate only one good site. This site was on a small farm near Baybay, where four excellent Sung porcelain pieces were dug from what appears to have been a 12th or 13th century grave. The largest piece is a beautiful dark-green celadon dish of medium size, with two well-formed fish impressed in the center. The ware appears to be definitely Lungchuan in type, as is also that of the second specimen, which is a small tub-shaped celadon dish of the usual style. The third piece is a medium-sized celadon jarlet with two ears; while the fourth and last is a good quality celadon bowl.

Crisogono Saceda's collecting.—In April, 1933, this collector also brought me several miscellaneous ceramic pieces from accidental finds in Leyte; and was also able to locate only one good site. In a field in the barrio or sitio of Punpunan, Baybay municipality, he located a midden site containing many fragments of common pottery, a few fragmentary iron tools and implements, and one stone artifact. Stoneware and porcelain fragments were wholly absent, and the appearance of the potsherds and other objects seems to be typically Iron Age. (This site should be reinvestigated and Iron-Age graves sought for.)

The Jacobs Collection.—While teaching in the Leyte High School at Takloban, in 1932–1933, Mr. Jacobs spent considerable spare time in investigating reported porcelain finds in northern and central Leyte, and ultimately collected between 50 and 60 good pieces, which were mostly shipped back to his home in New York in lots of about twenty pieces at a time. He states that about one-half of these were celadons of fair to good quality, and that the remainder were mostly Chinese blue-and-whites. He brought to me in Manila for identification one unique early 15th century green-and-white piece, lacking a cover, which he later donated to our collection. This piece and two or three other ordinary ones were found inside a large black-glazed jar of typical Early Ming type, which was excavated in a banana field in a small barrio about half-way between Palo and Carigara. One of the other pieces found in the jar was later acquired by Doctor Bantug, while the remainder were carried away by local citizens.

According to data furnished by Jacobs many pre-Spanish ceramic pieces are accidentally found throughout the northern half of Leyte Island. He states that the people frequently excavate old pieces in their fields, or find them washed out along the river banks. They usually treat such pieces carelessly, often allowing the children to play with and break them, or sometimes using them for household purposes or in feeding the chickens and pigs. In some barrios, however, the people fear the dishes and always either re-bury them in the ground or throw them into the river or sea. Very few local people seem to have any knowledge of the character of such wares, and think of them as belonging to the spirits or beings not human, although some of the wiser ones say that they belonged to their dead ancestors of long ago.

The last find reported to me by Jacobs, before he left the Philippines (1938?), was a good example of a small "hole-bottom" dish with a typical red fish in the center, together with two blue-and-white jarlets, all of Early Ming types, excavated together in a barrio field near Palo.

The Babcock Collection.—Much the largest old ceramic collection ever taken out of Leyte was that made by Mr. Orville Babcock, while he was acting as Division Superintendent of Schools for the province, and afterwards. Not all

of the Babcock Collection came from Leyte (see other sections from Camiguin Island, Lanao Province, and elsewhere), but the great majority of it did, particularly from the southern part of the province. The total number of pre-Spanish pieces from Leyte alone was not less than 300, of which more than half were Chinese blue-and-whites chiefly 15th and 16th century. I believe that all of this material was shipped to the United States about 1939, except for a few interesting damaged specimens which passed to the Roth Collection. I saw most of the pieces after they were brought to Manila, the most interesting single specimen being a medium-large and unusually perfect Khmer vase, of the type (10th century?) from Negros Island that will be later described. A few unique specimens or shapes are also of special interest, and the number of good Southeast Asia wares is unusually large. Several "red-bottomed" pieces are included.

Unfortunately, like many of our other general ceramic collections from the Visayan Islands, Babcock did not keep any accurate notes as to the sites and exact localities where the pieces were found, particularly as many of them were obtained through local teachers or other secondary sources. The material is therefore mainly of value only for typological and general study, and contributes but little to our distributional knowledge. It is to be hoped, however, that the Babcock Collection goes intact to some museum, and is not disseminated and scattered among individual collectors. (See Addendum, page 367.)

Hugo Miller's Collection.—The late Hugo Miller, who was killed in Leyte during the war, had a considerable number of good porcelain pieces (probably not more than 25 or 30 in all), mostly collected in the northern and western parts of Leyte Province. Most of them were Chinese blue-and-whites (chiefly 15th and 16th century), but a few Sawankhalok and Chinese celadons, and Ming jars, were also included. Several of the later acquired pieces were still in Manila in 1941, and were probably destroyed during the war; but the earlier lots had been sent to his home in Santa Cruz, California. Their present whereabouts is uncertain, as they have probably passed into the hands of relatives or other persons. While several of these pieces were interesting, especially a good 15th century blue-and-white bottle, there were no unique or exceptionally rare specimens among them.

Workers.—(As indicated under the various preceding items.) Also Teresa and Pedro Abella, Teofilo Palencia, Ceferino Montejo and Eulalia Brillo. [For additional data on Leyte, see Addendum.]

44. *Bohol Island and Province:*

(No tektites, true Stone-Age or Iron-Age remains, or early jar-burials have yet been reported from this Island. However, both Early and Later Porcelain-Age remains are plentiful, and many finds have been made. In fact nearly one-third of our general Visayan Islands Collection has come from Bohol,

but a large part of it is without proper site or locality identification. Only those sites about which we have some specific information will be listed below.)

Burial-cave explorations.—In 1914 Timoteo Butalid and Domingo Torralba reported that "there are many burial-caves both on the coast and in the interior of Bohol. The people fear them and they are usually entered only by birds-nest hunters (looking for the nests, or *saag*, of the *sáyao* bird, for which the Chinese pay from 3 to 5 centavos per nest). Bones, coffins, and other things in the caves are seldom or never disturbed by the local people."

The Guindulman caves.—Found about three miles east of the town, by Richard C. McGregor, of the Bureau of Science, in June, 1906, who collected two remarkably interesting skulls there and describes the caves as follows: "The two skulls . . . . were found in a coral-limestone cave, in the face of a cliff next the sea. There were three or four of these caves, all containing bones and remains of coffins. The openings of the caves were 10 to 15 feet above the water, and were not large enough to permit a man to enter standing erect. The coffins were in two parts, each made from a single piece of hard wood. Coffins and bones were much mixed up together, as though previously disturbed and pulled about. No beads or other materials were found, except some pottery. There were possibly as many as twenty coffins represented in the remains. The natives here do not like to enter the caves, as they say that many spirits, in materialized form, have been seen there." (The two McGregor skulls were destroyed during the war, but we still have good photographs and measurements of them.)

Luther Parker's Collection.—Three Bohol caves were explored by Parker prior to 1914: (*a*) One on Panglao Island; (*b*) very good one at Loay; and (*c*) one at Kandihay.

All of the specimens obtained were taken to the United States, and were deposited either in the Michigan University Musuem, the Field Museum of National History (Chicago), or are kept at Parker's present home in Santa Cruz, California (311 Bay Street). He kindly furnished me with good photographs of the seven Loay skulls (still on hand), and of two coffins and some other objects (destroyed). His list of the principal specimens obtained is as follows: Seven deformed skulls and some other bones from Loay; one carved wooden coffin lid from Loay; one hardwood loomstick (*pudan*) from burial niche above Loay cave; one iron knife originally wrapped in cloth, the texture of which can still be seen in rust-cake from the very dry Loay cave; a large collection of ornaments from Loay, containing shell bracelets, a bone bracelet, one stone bracelet, one copper or bronze bracelet, a blue-glass bead, some fragments of other shell ornaments, and other objects. Also quantities of Chinese ceramic fragments; and, in the burial niche above the main cave, some deeply buried

fragments of plain and decorated native pottery. Ceramic fragments and bones were found in all three of the caves. Stories of gold ornaments being found in the caves are current among the local people, but no actual specimen could be located.

Doctor Guthe's cave excavation.—In addition to investigating 17 caves, 35 burial grounds, and 55 individual land-burials, 1922–1924, Dr. Carl E. Guthe excavated carefully the single large cave in Sukgang barrio, 7 kilometers east of Loay. This cave is beside the main south road of the Island, and is readily accessible. Doctor Guthe and a force of local laborers spent four weeks in completely excavating the cave and the talus slope just outside the lower entrance. (From the description, it is possible that this is the same cave investigated by Luther Parker some ten years earlier.) Besides the much-disintegrated remains of some wooden coffins, the following specimens were obtained: 79 celadon or green-glazed ceramic fragments, plus 40 grey, 26 white, and 31 brown glazed; 40 blue-and-white and 23 black-and-white ceramic fragments; 4 over-glaze decorated; 7 unglazed stoneware, and 28 fragments of dark jars; 19 fragments of native pottery; 2 iron implements or weapons; 5 specimens of copper or brass, and 1 of lead; 4 gold ornaments, and 1 of glass; 1 bead, and 13 shell ornaments; 11 skeletal specimens; 3 stone specimens, and 4 miscellaneous; or 342 specimens in all.

No stratification was observed, as the deposits had been much disturbed by the elements. The records of Doctor Guthe's other Bohol finds are doubtless with the specimens in the Michigan University Museum, but are not now available in Manila.

S. Warner's specimens.—In 1917 or 1918 S. Warner (formerly of Siassi) gave two interesting Bohol cave skulls to Doctor Ruthven, head of the Michigan University Museum. (No record of the exact cave is available here.)

Gilbert Perez' Collection.—Before the war Mr. Perez had one fine-quality specimen of a whole bracelet made from a rare red-brown type of glassy paste (opaque), found in a Bohol site together with some porcelain pieces, shell bracelets, iron weapons, and other objects, but the locality and type of burial is not stated. (The collection was destroyed or disseminated during the war.)

Possible Stone-Age specimens.—In a letter to me dated in November, 1924, Doctor Guthe mentioned one possible palaeolith and two late Neolithic adzes being found in Bohol, but did not give the locality or circumstances. (They are probably in the Michigan Collection.) [For further details on these specimens, see Addendum.]

A land-burial site.—In October, 1925, an almost complete skeleton was found in an ancient burial site on top of a hill at Calape, while the excavation for the reservoir of the Calape waterworks was being made. The skull, mandible, and 74 miscellaneous whole and fragmentary bones were collected by the

District Engineer and presented to the University Collection. (Unfortunately, no pottery fragments were collected, and it is thus difficult to date this find.)

Porcelain-Age sites.—Some of my regular collectors have recorded specific sites in Bohol, and these are worthy of brief discussion:

Pedro Menguito's Collecting.—In July, 1931, Menguito obtained a nearly whole Chinese 15th century blue-and-white dish of good quality from a farmer who had just excavated it in a field in the barrio of Tagbunân, back of Sikatuna town. He did not have time to investigate the site further, beyond gathering a few additional broken 15th century fragments from the field.

In November, 1932, Menguito made another trip to Bohol, and this time obtained five whole ceramic pieces excavated from a single site in the town of Dimiau, together with two packages of mixed ceramic fragments from the Dimiau fields, and from some other fields in the nearby Cabad barrio of Cortes municipality. The Dimiau site appears to be a 15th century burial-ground, since not only are the five whole pieces all early 15th century but also the fragments from Dimiau fields appear to have come from a relatively small number of once whole 15th century pieces, probably broken up and scattered by previous cultivation. The package from the Cabad site shows one nearly whole *kylin* plate and a large number of blue-and-white fragments, nearly all of Chinese 15th century wares. (I instructed Menguito to investigate this area further, and he made another trip near the end of the year.)

In February, 1933, Menguito returned from his second trip to the Cabad Site, in Cortes, with the following collections: Two whole blue-and-white dishes from the same middle or early 15th century area, including another *kylin* plate. A large package of mixed midden fragments from adjoining fields, containing 7 Chinese blue-and-white, 10 Chinese celadon wares, and 1 large fragment of a Sawankhalok celadon. It is thus probable that the midden site is at least two generations older than the land-burials containing the whole pieces. The proportional poverty of Sawankhalok specimens points definitely toward a middle or late 15th century culture, when the Siamese pieces had already largely disappeared from the trade.

(Menguito made another, and still more successful, trip to Bohol shortly before the war. This will be taken up after first discussing the Hester Collection.)

E. D. Hester's Collection.—In 1939 Mr. E. D. Hester made an extensive trip through Bohol Island and located several interesting archaeological sites. One of the potentially most important is a very extensive midden site just to the east of Tagbilaran, where a very large and variegated pre-Spanish settlement must have been located.

The fragment collection seens to indicate two or three distinct periods of inhabitation, the first of which goes back at

least as early as the 9th or 10th century, A. D. There may have actually been more or less continuous inhabitation from the 9th or 10th century down to the Spanish arrival in the 16th century, but with two or three shifts of the population center. Sawankhalok wares are largely represented in the middle period of the three, but not in the first and last.

One of the characteristic common pottery wares in the earlier part of the site is the very decorative Cambodian or Southeast Asia pottery type named "Kuta Tinggi" by me, on account of its great prevalence in the Kuta Tinggi site in the Malay Peninsula. (A large collection of this material is stored in the Raffles Museum at Singapore, and was examined by me in 1938, liberal samples being brought to Manila for our comparative collection.) Mr. Hester collected many typical sherds of this ware—particularly of the decorated forms—in the Tagbilaran site. Also a considerable number of both plain and decorated fragments of genuine Cambodian stoneware, of types only known from the 9th to the 12th century. (This site is deserving of special future study and more extensive collecting.)

Menguito's last Bohol lot.—In June–July, 1940, Menguito made his last collecting trip to Bohol prior to the war. He obtained nearly a dozen good pieces of pre-Spanish Chinese and Sawankhalok wares (mostly without specific site data) from accidental finds, and one unique whole piece that was definitely the prize of the lot. This is a large common pottery round-bottomed jar or pot, decorated over the whole body with a typical "Kuta Tinggi" design. It was excavated in a ditch, several kilometers to the east of Tagbilaran, somewhat beyond the Hester site; but both the decoration and the bodyware are identical with many of Hester's fragments. This is the first whole piece of this ware to be found in the Philippines, and it is thus of exceptional interest. (The body is 30 centimeters wide by 20 centimeters high; and, considering the thinness of the ware, it is rather remarkable that it has survived unbroken for so long a time.)

Workers.—(As indicated under the various preceding items.) Also Dean C. Worcester, and Major Eugene de Mitkiewicz.

45. *Siquijor Island* (*part of Oriental Negros Province.*)*:*

(As early as 1918 the late Governor James R. Fugate told me of having seen many pieces of pre-Spanish ceramic wares, in Siquijor, that had been accidentally excavated during the carrying out of the public works program that he had initiated there. The first actual collecting and preserving of such pieces, however, was begun by Dean C. Worcester. Luther Parker also explored a cave near Larena, prior to 1913, and obtained a small carved wooden coffin, some skulls and other bones, a quantity of interesting potsherds, and some shell ornaments. The cave was about one kilometer south of Larena, and many other burials in niches and rockshelters were seen in the vicinity.)

Stone-Age remains.—No tektites or palaeoliths yet reported. Governor Fugate told me, in 1918, of having seen two or three polished stone adzes in the hands of old people on the Island who regarded them as "lightning stones" having magic properties.

In November, 1924, Dr. Carl Guthe sent me two photos of a fairly good specimen of a plain-backed rectangular Late Neolithic adze from Siquijor. (He does not give the locality, but it is doubtless entered in the catalogue of the Michigan Collection.)

Guthe-Brown Collection: Porcelain-Age remains.—The principal work on this Island was the general survey conducted for Dr. Carl Guthe, 1922–1924, by Mr. Harry Brown, but specimens were actually collected from only a small part of the numerous sites listed. Doctor Guthe lists a total of 79 separate sites from Siquijor, of which 14 are classed either as "miscellaneous" or "doubtful." Of the remaining 65 good sites, 13 are caves, 21 burial-grounds, and 31 individual land-burials or accidentally excavated graves.

Doctor Guthe does not list exact localities or contents of these sites; but all of this data is duly recorded in the carefully-made card-catalogue of sites kept by the Michigan Expedition, a copy of which is doubtless still in Ann Arbor.

Workers.—(As indicated in the preceding items.)

46. *Cebu Island and Province:*

(This Island is the most thickly inhabited in the Philippines, and it has also been more thoroughly explored archaeologically than any other area outside Rizal and Batangas Provinces. Most of the work has been rather unsystematic, however, and the finds have been chiefly of the Porcelain Age and the Late Iron Age. It is highly important that further systematic work be done there—particularly on the western side of the island, and over the southern third especially—and that more attention be paid to earlier remains.)

Tektites.—Although tektites have been several times reported from Cebu, the first actual site was not located until October, 1940. This was found by a farmer in a small hill barrio in the south-central part of the Island, and was examined by my collector, Pedro Menguito, who found three good specimens in a primary site covered by from one-half to a full meter of soil and clay. (The specimens were not properly examined by me until 1941, and war developments prevented any further exploration of the site.)

Neolithic Stone-Age remains.—Doctor Guthe found one good small trapezoidal Late Neolithic adze (plain-backed) in Cebu, of which he sent me a good sketch in November, 1924, but it was without any data as to exact locality.

Kenneth B. Day had, prior to the war, a very good specimen of a black hornrock stepped adze of early type, found in cutting down a new road bank on the Cebu-Toledo road,

near the crest of the ridge. (I have good photographs and measurements of this specimen.)

Rodrigo Velez, of Cebu, had in his possession in 1938 two Late Neolithic adzes or chisels, both of which had been found in central Cebu, but without data as to exact locality.

My own Cebu collection contains the following true neolithic specimens: 3 stone adzes, 1 worked stone-hammer, 2 barkcloth beaters, and 3 worked objects of uncertain use. One curiously-grooved barkcloth beater and the worked Neolithic hammer were both found on a small hill farm in south-central Cebu, but the exact locality was not stated. The largest barkcloth beater (horned), and two good Middle or early Late Neolithic adzes (plain-backed), were all found in one field in the hill barrio of Banilad, Ginatilan municipality. One other good semi-gouge type of early Late Neolithic adze, and a black stone object that was possibly the body of an Early Neolithic tool (oval in cross-section), were both found in one field on a small hill farm on the mountain back of Minglanilla, while the farmer was levelling a small hillock or mound, in 1937.

Bronze-and Iron-Age remains.—No true Bronze-Age artifacts have yet been reported from Cebu, but Late Iron-Age remains certainly exist. Most identified specimens are in my own collection, and it will be more convenient to discuss them in connection with the Porcelain-Age sites, below.

Porcelain-Age finds in general.—Cebu Island is truly a mine of ancient porcelains and other artifacts of pre-Spanish times. Morga relates how diligently the Japanese were searching for ancient porcellaneous wares there in the 16th century, and we are still finding other deposits in the same areas that they covered. (It was perhaps fortunate for our present research, however, that Japan was closed to the outside world—temporarily in 1624, and permanently in 1640.)

In modern times, also, Cebu has been the field most worked by ceramic collectors, some scientifically inclined and many otherwise. Some of these collections have been taken to the United States, France, England, Japan, and China; others were destroyed during the war. It will be mainly our purpose here to discuss only those that have scientific importance, particularly in relation to specific sites or unusual finds, collections lacking definite records to be disregarded.

Among the latter are the following collections, all formerly in the hands of residents in Cebu City: The very good Sequera Collection (mostly of selected celadons); the Rodrigo Velez Collection; and smaller collections in the hands of Doctor Patalinhob, Mr. Gibberson, Mrs. Briones; Mrs. Pascual, and a few others. Also the Kenneth B. Day Collection, in Manila, some pieces of which were of exceptionally fine quality (several photographed and measured for my records.)

The earlier Cebu collections of Major Eugene de Mitkiewicz (mostly acquired by Dean C. Worcester and W. Cameron

Forbes) will be referred to only where I have records of specific finds; and the same will be true for the Dean C. Worcester Collection, which was afterwards combined with Guthe's Michigan Expedition material.

The former National Museum Collection, made by the late Manuel de Iriarte with advice from myself, was mostly from Cebu Island—the pieces having been collected chiefly by Mrs. Pascual and the Abella family. Most of them were photographed for my records, but very few specimens had any adequate site data. (More than half were destroyed during the war.)

Doctor Guthe's Michigan Expedition Collection.—During his 1922–1924 work Doctor Guthe recorded 204 sites in Cebu, excluding 11 others marked "miscellaneous" or "doubtful." Of the accepted sites 17 were caves, 65 burial-grounds, and 122 individual land-burials or accidentally excavated graves. While records of these sites exist in the Michigan Museum, Doctor Guthe's report lists the contents of only two, which may be described briefly as follows:

The first was a burial-ground on a hilltop, located about 20 kilometers southwest of Cebu City, later destroyed by the operations of the Naga cement works. Doctor Guthe and his party spent three days excavating the site. Thirteen skeletons were found, buried at full length, and with only a few inches of earth remaining over them. The following additional specimens were obtained—mostly associated with the burials: 6 green ceramic specimens, 2 gray, 1 white, and 2 brown; 1 blue-and-white and 4 black-and-white ceramic specimens; 1 dark-glazed jar and 2 unglazed stoneware pieces; 3 pieces native pottery; 3 iron tools or weapons, and 1 stone specimen; 3 beads; 2 shell specimens; 1 bone; and 5 miscellaneous; or 37 specimens in all.

The second site was one originally reported by Juan Abella, Guthe's chief field agent in Cebu. It is described as a single burial at full length, about 20 inches below the surface. Located in Talot barrio, near the town of Carcar, on the southeastern coast of the Island. The following specimens were either associated with the burial or were picked up on the surface nearby: 33 ceramic pieces and fragments, of which 28 are green, 3 grey, and 2 white (indicating a pure Sung-period site); 1 iron tool or weapon; 1 gold ornament; 1 stone specimen; 1 bead; and 3 shell ornaments; or 40 specimens in all.

A large number of other whole and broken ceramic pieces were obtained from agents, without reliable site data.

Beyer General Philippine Collection; Cebu Section.—My Cebu specimens were all originally put into what was known as the "General Philippine Collection" with key-letter "G". As 80 per cent of the "General" collection came from the Visayan Islands, it was later split into two parts—one part being called the "Visayan Islands Collection", but the key-letter on

the specimens has not been changed. This Visayan Islands Collection is the largest of all our collections outside the major Rizal-Bulakan and Batangas areas; but, for the purposes of the present paper, it will be more logical and satisfactory to follow the original catalogue arrangement and terminology.

The material may be divided under three general heads, one of which may be treated very briefly. For Cebu this latter heading covers more than one-half of the total material, and consists of those specimens for which we have no accurate site data. The basic reason for the quantity of this material is as follows: Doctor Guthe's three years' work in Cebu stimulated a great deal of private collecting and a certain amount of commercializing of the "antique" trade there, so that many valuable specimens were passing into private or foreign hands, and being lost to scientific record. The only practical way to stop this was to buy up all available material in private hands, together with such records as were available, which were usually at least sufficient to define the general area from which the specimens came. (Such material is of much value for typological and "general area" studies, when supported by a sufficiency of true "site" material from systematic work.) The specimens were mostly gathered by a group of trustworthy agents (some of whom had previously worked for Worcester or Guthe), passing from town to town and through the countryside, and their work resulted not only in accumulating much valuable material, but also in locating a number of important new sites and areas.

Of the materials for which site records are available, we may first consider a group of miscellaneous early collections, after which the work of my two most efficient field workers and collectors, Crisogono Saceda and Pedro Menguito, will be taken up.

Various early explorations and collections.—Some time in July, 1929 Marcelo and Juan Abella, under the supervision of Major Eugene de Mitkiewicz, excavated a small group of very early graves in the central part of Cebu Island just back of Cebu City. Twenty-seven pieces of Sung porcelain and stoneware were obtained, which were brought to Manila uncleaned and still filled with the original earth. All of the pieces would normally be dated as being between the 11th and 13th centuries, and it is obvious that we had here an undisturbed burial place of the 12th or 13th century. None of the skeletal material was collected, as it was badly disintegrated. Nearly half of the ceramic pieces were celadons of varying quality, six being definitely of Lungchuan ware, while the others were partly white T'ing wares, grey or brown jarlets, saucers, and bowls, plus one small curious ewer or water-pot with a handle and spout. The largest was a fine deep dish of Lungchuan ware, 14 inches in diameter; while

a covered celadon jar, 8 inches in diameter, is also noteworthy. (No jewelry or metal objects were found.)

On June 4, 1930, M. Kelley, of Cebu, brought me three sample specimens and an interesting account of some finds on Camote Island, in the eastern part of the province. These specimens and a number of others were found washing out of a medium high bank near the beach, in Santiago barrio. The first specimen is a piece of a finished but broken shell-bracelet, the second is a piece of *tridacna* shell from which a large disk has been cut by a circular drill, and the third is a shell disk which just fits into the opening in the second piece. In other words we had here a shell-bracelet factory—and what Mr. Kelley found was the midden dump of wasters from such work. He states that at least a good-sized basketful of such wasters could be gathered there. The shape and characteristics of these bracelets seem identical with those found in so many 12th to 16th century burial-places, caves, and other sites throughout the central Visayan Islands—and this factory doubtless dates from somewhere within that period.

In July, 1932, Irineo Quiñanola, an employee of the University Library, made some interesting finds in an old burial site located on a gently sloping hillside about half a kilometer above the creek or small river running through Anao barrio, about 10 kilometers from Malabúyok, southwestern Cebu. Many graves had been found from time to time on this formerly forested hillside, first put under cultivation in recent years, and some of the porcelain specimens found had been sold to collectors in Cebu, and perhaps some to my own agents. The material brought by Quiñanola, is mostly fragmentary, having been gathered around the formerly excavated graves, but it is nevertheless of unusual interest. In addition to good broken pieces of 14th and 15th century wares, both Sawankhalok and Chinese, there are three pieces of unusual shell-bracelets, two iron dagger blades or small spearheads, and three iron knives or other tools. (For later notes on this site, see Menguito's work, below.)

Collecting work of Crisogono Saceda and his brother Pedro.—In January, 1931, Pedro Saceda found a small undisturbed burial-ground in a field, about half a hectare in extent, a short distance inland from Argao town. Following my instructions, he carefully excavated two or three adjoining graves of the land-burial type, and brought the resulting specimens to me in Manila uncleaned and still filled with the original earth. He also obtained another good piece accidentally plowed up in the same field by the local farmer, whose discovery had originally led us to the spot. Thirteen whole ceramic pieces were obtained in all, of which four are Chinese 15th century types (one celadon and three blue-and-white), six definitely Sawankhalok, and the remaining three of supposed Southeast Asia origin (one "red-bottomed", and two of

the peculiar and distinctive blue-and-white pineapple or cactus design). The finding of the above group of wares together, in what appears to be definitely a 15th century group of graves, established a landmark in our ceramic chronology. All of the significant pieces can be dated definitely within the first half of the 15th century or the last half of the 14th century, as to period of manufacture.

Also early in 1931 Crisogono Saceda brought in two very significant lots of material from two widely separated areas—the region just back of Cebu City, and the Ginatilan area near the south end of the Island.

The first lot came from a single grave, at a place called Himamawan, very near the locality called Pañgol, in the mountains back of Cebu City, where the Forbes type-specimen of the "pineapple" type jarlet was originally found by Major Mitkiewicz prior to 1920. The Himamawan grave lot was also brought to Manila uncleaned and with the original earth fillings still intact, and when we carefully cleaned it up, in the laboratory, Saceda and I had one of the most pleasant surprises of our Cebu work. In addition to several ordinary pieces of usual 15th century types, the lot contained the most perfect specimen we have ever found of the curious blue-and-white "pineapple" type jarlet. And upon our carefully removing the earth, we found inside twenty-three small gold beads and tiny rings of twisted gold wire. The "pineapple" type of jarlet, of which we now have some ten different specimens, has been the object of a special manuscript study by me—shortly to be published—but we have not yet determined the exact provenance, although it seems fairly certain to be somewhere in Southeast Asia. (Neither the bodyware nor the designs are Chinese in type, and it shows distinct kinship to the interesting Southeast Asia group of "red-bottomed" wares.) The gold beads are rather distinctive, but show the same general welded "pellet" type of structure so characteristic of old Philippine gold work everywhere. (Another 14th or 15th century gold finger-ring of similar workmanship was later obtained from an Argao site.)

Ginatilan area.—In addition to uncovering the first definite Late Neolithic site in Cebu, Saceda's 1930–1931 work at Ginatilan produced many other interesting finds, and led ultimately to this area becoming our most important field of systematic work in the entire Island. The best work was done there in June, 1932, when a group of adjoining burial sites in the barrio of Banilad was more or less systematically excavated by Saceda and his brother, following my directions. Later Pedro Menguito continued the Ginatilan work, bringing in two good lots of material, in August and September, 1932, and a third good lot in February, 1933.

The Ginatilan area contains a number of sites, the most important being those located in and around Banilad barrio.

What may be termed Banilad Site No. 1 contains three distinct horizons:

(*a*) *Late Neolithic.*—Containing adzes, barkcloth beaters, worked mullers or hammer-stones, etc.
(*b*) *A Late Iron-Age* period of inhabitation, shading into the time when Late Tang and Early Sung porcelains appear.
(*c*) *A Middle Porcelain-Age* period, probably confined to the 13th and 14th centuries only, in which Chinese wares appear associated with early Chaliang and Sukhotai, and perhaps some Kalong and Indo-China monochrome specimens also.

One grave, in this site, containing only Sung-type porcelains, produced also a whole shell bracelet and five much corroded green-and-blue glass beads of medium-large size. Several excellent celadon bowls, of typical Early Sung Korean and North China form, were also obtained.

In what appears to be the mixed Late Iron-Age and earliest Porcelain-Age section of the site, a most interesting collection of partly disintegrated beads and better-preserved glass and shell bracelets, and some other ornaments, were found associated with native pottery fragments and a considerable number of disintegrated iron weapons and tools. Some large pottery beads or net-weights (similar to those from the Tagig Site, in Rizal Province) were also included. In one part of this same area Tang-Sung ceramic fragments were found, and at least two graves containing whole Sung porcelain pieces.

At least half of the beads found, including some of agate and carnelian, are distinctively of Iron-Age types; but some of the others, and several of the larger paste bracelets, are more like Early Porcelain-Age types of probable Cambodian or other Southeast Asia origin. Some of the translucent glass bracelets, particularly the dark cobalt-blue types, also closely resemble some that I have seen in the Hanoi Museum—found in Cambodian or other Indo-China sites.

Banilad Site No. 2.—This site first found by Saceda but more extensively explored by Menguito, lies in a *kaiñgin* on top of the hill just back of the first Banilad site, and seems to be chiefly of 15th century date. This site contained both a midden site and a small burial-ground, and a number of good Chinese blue-and-white porcelains (including three large dishes) were obtained there.

Additional Ginatilan finds by Menguito.—Near Banilad, but not connected with the first two sites, Pedro Menguito later found several other small burial sites and midden dumps—mostly seeming to date between the 14th and 16th centuries, but including at least two of earlier Sung-period type. From these he obtained a total of twenty-one whole porcelain pieces

of interesting types, in addition to several large packages of fragments, a few shell bracelets, beads, and metal objects. Some curious shell earrings, and two beads of old Greco-Roman types, are especially worthy of mention. Also one turquoise bead, a rare article in Philippine sites.

Menguito also found in the barrio of Conyorong—a considerable distance from Banilad—what appears to be an old broken-down cave, or rock shelter, some distance inland from the present coastline. Here, in addition to a considerable fragment collection, he dug out an interesting whole Sawankhalok celadon dish of large size and of an early type (probably 14th century), but it is unfortunately covered with a tough lime deposit which is difficult to remove.

The whole Ginatilan area is still worthy of extended systematic exploration, as there are doubtless still many other valuable finds to be made there.

Other collecting work in Cebu by Pedro Menguito.—Additional work in and around the Anao barrio site, at Malabuyok, was done by Menguito in 1932–1933. Besides securing five good whole ceramic pieces, he obtained considerable data about the site which seems to indicate that it is definitely of the 13th and 14th centuries, and not quite as late as previously thought. It may be that one or two later graves were intruded into the area.

The productive Badiang area.—This area, also on the west coast some distance to the north of Malabuyok, was the scene of Menguito's chief collecting activity in 1932-1933, and proved to be one of the most productive areas yet found in Cebu Island. The best sites are in and around the barrio of Bugas, although some other neighboring barrios were also explored.

Results show that the Bugas barrio area was inhabited chiefly during the 13th and 14th centuries—more than two-thirds of the porcelain pieces found being of Late Sung and Yuan dates. The midden-dumps in the area are also at least 60 per cent definitely pre-Ming. Only a very small percentage of non-Chinese wares, indicating intercourse with Southeast Asia only near the end of the period. And only one whole blue-and-white piece came from the entire area. Apart from more than a score of interesting ceramic pieces and quantities of midden fragments, the area produced seven bracelets (two being of unusual types), fourteen old beads (three of Greco-Roman types), and quantities of more-or-less disintegrated iron weapons and implements.

Such Ming remains as appear in parts of the Bugas area are separated, in point of time, by more than a century from the earlier period of inhabitation; as they date only from the late 15th and 16th centuries, while the earlier period came to an end about the middle of the 14th century, if not before.

Other sites.—In January, 1933, Menguito found a new site in the barrio of Buad, between Oslob and Caceres on the

southeast coast. This produced twelve good ceramic pieces, probably all of 12th or 13th century types.

In November, 1932, both Saceda and Menguito collected a number of fair quality specimens from a barrio called Laguasan (or Lagnasan), in Caceres municipality. Saceda obtained ten good ceramic pieces (mostly celadons) and Menguito one, all apparently Sung or Yuan productions dating between the 12th and 14th centuries. Most of them were excavated in one field, by the farmer owner, under Saceda's direction; and no beads, bracelets, or other ornaments were found either in the graves or in the field, while practically all of the skeletal material had disintegrated.

Cebu-Carcar Road finds.—While a new section of the Cebu-Carcar road was being built through Valencia barrio (of Carcar municipality), early in 1933, two early graves were uncovered containing Sung celadon dishes and a remarkable collection of old beads and opaque paste bracelets. Menguito saw the dishes but was unable to obtain any of them, as they were all appropriated by the legislative representative from that district—but he did acquire eight whole bracelets, one broken bracelet, and thirty-four of the beads. Thirty of the beads were of Greco-Roman types, the largest single hoard of such material that has yet been found. It is obvious that these two graves were those of wealthy men, or chieftains, and it is possible that the graves also contained some gold ornaments which were sequestered by the workmen. Six of the larger bracelets (red-brown, orange, yellow, green and cobalt-blue) are of the types that I believe to be of Cambodian or Southeast Asia origin.

Another bead find.—In June, 1932, a farmer accidentally excavated an early burial in a kaiñgin in a mountain barrio of Dalaguit town, lying back of a point about halfway between Oslob and Argao. This find may be genuinely Early Iron Age, as neither the farmer nor Menguito who visited the place, could find any porcelain fragments in the field. Common potsherds, rather finely broken through cultivation, were fairly common; and they all seem to be of recognized Iron-Age types. Among the beads obtained by Menguito from the farmer are three large carnelians (all more or less damaged by fire) and three Greco-Roman beads of the earliest types known in the Philippines (two "eye" beads, and one early spiral type). These beads are practically identical with those found in the Novaliches Iron-Age sites of Rizal Province, where they date back to a little before the beginning of the Christian Era.

Saceda's finds on Babag Mountain.—In April, 1933, Saceda found an interesting new site on Babag Mountain, in Guadalupe municipality, just to the east of a point halfway between Malabuyok and Badiang. Several kaiñgins were explored and were found to contain only monochrome porcelain

and native pottery. Several whole native pottery pieces were said to have been found by the farmers in the bead-containing graves, but all of them had been broken up by the farmers' children before Saceda's arrival. The objects of chief interest, however, are the beads glass bracelets, and ivory hilt ornaments. (No less than 223 medium-sized beads, and five ivory hilt-ornaments, were found with an orange paste bracelet of extra large size.) The evidence seems to indicate a mixed Sung-Porcelain and Late Iron-Age site, similar to several others discussed above beginning with Banilad barrio.

Further finds back of Cebu City.—In 1933 Menguito visited the Himamawan (or Mamawan) site, previously discussed, and obtained five more unusually good pieces, of which four were 14th and early 15th century Sawankhalok wares of chronological interest.

Three other finds from Cebu and vicinity are worthy of mention: From the waterworks area, back of the city, came a Ming Buddha-image (15th or 16th century) of a greyish-white jade; two other almost identical specimens have been found in Cebu Island sites. A second find, obtained from a resident of Tisa barrio, who claimed to have excavated it on his hill farm back of the City, is a very good Middle Ming blue-and-white jar, 18 inches high, with six ears and a deep violet-blue design, collected by Saceda. A third find, collected by Menguito, is a dark olive-green Late Sung or Yuan celadon dish, which was excavated and broken while digging postholes for a house in Talambang barrio.

Kandulawan Mountain Site.—In April, 1933, Saceda traced another reported find to certain fields and kaiñgins on Mt. Kandulawan, in the municipality of Talisay. This brought to light another fine lot of early beads (much corroded) and bracelet specimens—this time, rather curiously, all of orange-yellow and milky-green colors only. All of the 114 paste beads are said to have been found in two adjoining graves, accompanied by two large yellow-paste bracelets. Only native pottery and monochrome porcelains were found with them; and the whole set-up appears to be very similar to that of the Babag Mountain finds previously discussed. (This site is not very far from the main south road, and further exploration should be carried out there.)

General Cebu Porcelain-Age data.—The specimens from the above listed sites, together with our miscellaneous Cebu pieces, totalled more than 1,200 whole or nearly whole ceramic specimens (of which about one-half were destroyed during the war), together with more than two tons of ceramic fragments, and a large number of ornamental objects (more than 1,000 beads and bracelets), tools, and miscellaneous material. (Of the ceramic material about two-thirds is Chinese, and one-third non-Chinese—most of the latter being Southeast Asia, less about 5 per cent of native wares.

Workers.—(As listed under the preceding various items.) Also Pedro and Teresa Abella, E. Duterte, and the late Engineer Crespo, of Fernandez Hermanos. [See Addendum for further data on Cebu.]

47. *Negros Island* (*Oriental and Occidental Negros Provinces*):

(This island, anciently known as *Buglas*, has been but little explored archaeologically except along parts of the eastern coast; but several very important accidental finds have been made. Historically, it is the source of some of our most important records; and it should receive more specific archaeological attention in the future.)

Tektites.—I have examined only one genuine natural tektite from this Island—a well-grooved and pitted discoidal specimen in the hands of Fr. Miguel Selga, about 6 centimeters in diameter and said to have been found in a sugarcane field in the north-central part of the Island. (It shows some signs of wear, and may possibly be a transported specimen brought there as a charm-stone.) No pre-Neolithic Stone-Age remains are yet known from Negros.

Neolithic finds.—Two plain backed Late Neolithic adzes of fine quality have been found at widely separated points in Negros Island; while a probable fragment of a Late Neolithic spear-head was found by me near Dumaguete in 1939. The first adze reported to me was found around 1930 at the San Carlos Sugar Central, while excavating for building a shed. The specimen was taken to the United States by one of the members of the technical staff.

The second and best adze is in the hands of Dr. Cornelio C. Cruz, and is a fine large rectangular specimen, well polished and made of a mottled red agate or carnelian (or possibly an unusual variety of nephrite, as it has not been tested mineralogically). It was found while a ditch was being excavated in a sugarcane field, near the Malogo River, at Victorias, western Negros, about 1929. (I have photographs and measurements of the specimen.)

Early Iron Age.—One of the most interesting finds yet made on Negros Island is that of an Early Iron-Age clay pot, with incised decoration and in perfect condition, which was found in 1913 by workmen excavating a guano deposit in a dry cave near the barrio of Taboso, Escalante municipality, in the northern part of the Island. This was brought to me in the same year by the late Fred L. Pray, and was still partly filled with a black substance that was probably charred food. When found, it was buried with four other similar decorated angle-pot specimens under a little over 2 meters of bat-guano, but the other four pieces were unfortunately broken by the workmen, and the fragments thrown away. Two of them are said to have been larger, or at least taller, than the present specimen. Pray's study of the guano caves, and my own

study of the characteristics of this specimen, both lead to the opinion that this pot dates back to the beginning of the Christian Era, or a little earlier. (Further investigation of this area should be carried out, and the talus from the caves should be excavated and screened for potsherds and other objects.)

Porcelain-Age explorations.—Very little work was done in Negros Island by the Michigan Expedition of 1922–1924, and Doctor Guthe lists only one site (a cave) visited in Occidental Negros without any details as to location or possible finds. In Oriental Negros, however, Mr. Worcester had found and excavated a very interesting large burial ground at Vallehermosa before the Expedition arrived. In addition to this, Doctor Guthe lists only 5 other sites of which two are marked miscellaneous or doubtful, while the remaining three are individual land-burials or accidental finds only.

The following details are given concerning Mr. Worcester's excavation: The site was near the village of Tabon, just south of Vallehermosa town, and consisted chiefly of jar-burials. The following ceramic specimens were found (the number of whole pieces not being indicated): 46 green, 22 grey, 12 white, and 14 brown-glazed; plus 2 dark jars, 2 unglazed (stoneware), 13 pieces of native pottery, and 2 unclassified. Of other objects, there were 2 iron, 2 copper or bronze, 4 gold ornaments, 1 lead, 1 glass, 2 stone, 3 shell (bracelets?), 1 bead, 3 skeletal, and 1 miscellaneous, making a total of 133 specimens in all. (No blue-and-white, or other polychrome specimens of any type, were found. It is therefore obvious that this is a Sung-period site, and possibly a very early one; and it would be interesting to have an account of the material obtained fully written up. It is a real handicap to cther workers that so little of the Michigan material has been adequately described.)

Saceda's collecting in Oriental Negros.—Most of the specimens in my General Philippine Collection from eastern Negros were collected by Crisogono Saceda in 1930. Although he made small collections from several sites, only one seems to be of major importance—located in Lupak barrio of Mañguyod municipality.

The Lupak barrio site.—As found the site lies in and along the edge of a river bank in Lupak barrio, and appears to consist of a large midden site bordered by or interspersed with a group of Porcelain-Age graves dating chiefly from the 12th to the 14th centuries. One edge of the midden site shows a little early 15th century material; and it is possible that the lower strata of the deposit go back to a time before the 12th century. As a whole the midden site runs about 75 per cent Chinese wares, and 25 per cent Siamese (mostly Sukhotai), Cambodian, and other Indo-China material. (One fragment of an orange paste bracelet, and a few pieces of native pot-

tery, seem to have come from another area outside of the Lupak Site proper.)

However, the most striking feature of the Lupak Site is the presence of a whole (but damaged) Cambodian large vase, from one of the graves, and several fragments of the same ware washed out from the midden deposit along the river bank. (The question here is: "Did these apparently 10th century Cambodian pieces come to Negros with the definitely 14th century Sukhotai wares, or at some earlier time?")

The Pavon and Loarca historical data.—As Miguel de Loarca's 1589 narrative has fortunately been printed in full in volume 5 of the Blair & Robertson series, it is unnecessary to do more here than to mention that it contains invaluable data concerning the pre-Spanish history of Negros, as well as concerning the grouping, characteristics, and customs and beliefs of the inhabitants.

The three surviving columes of Fr. José Maria Pavon's manuscripts (originally in nine volumes of which six have apparently been lost), written in Himamaylan in 1838–1840, were obtained for the National Library in 1912–1913 by Dr. James Alexander Robertson with the aid of José E. Marco, of Pontevedra. These volumes, entitled "Las Leyendas de la Ysla de Negros" (parts 1–3), contain—in addition to much folklore and ethnological observation—a remarkable series of ancient documents translated from originals in the old Visayan syllabary, allegedly dating from the year 1372 and after. They were accompanied by three actual documents written in the old syllabary, on a kind of palm-bark with cuttle-fish ink. (The originals of all the Pavon and bark manuscripts were destroyed with the National Library during the war. Fortunately, however, I still have good photographs of the bark manuscripts and of many Pavon pages, as well as complete typewritten copies of all.)

In addition to Pavon's rich data on pre-Spanish customs and events in Negros, he also provides a lengthy list of ancient fortifications and monumental remains. (The sites of these, wherever still identifiable, should be carefully explored archaeologically.)

He further states that documents in the ancient writing were still fairly plentiful among the pagan mountain people in 1838, although only a few native priests and magicians could read them, and they were treasured chiefly for their magic properties. (Search should be made for any still in existence.) In his day the Negritos were still quite numerous, but the lighter skinned mountain folk were known as "Mangyanes." (What is their relationship, if any, to the Mangyans of Mindoro, Tablas, and Sibuyan?)

Workers.—As indicated under the preceding various items. Also Luther Parker, Emilio B. Tarrosa, Francisco Varona, Dr. Juan Mañanos, Mountaineer Ynoy, Juan Collado, Norberto Romualdez, and others.

48. *Guimaras Island (part of Iloilo Province)*:

(This island is rather flat, and archaeological discoveries have been few. No remains prior to the Porcelain Age have been reported; but the island has long been thickly inhabited, and systematic search might produce surprising results. No specific sites have been reported (except one indicated but not named by Doctor Guthe), but a few individual land-burials have been accidentally excavated from time to time. The only ceramic pieces that I have seen, reported to have been found in this Island, were of Yuan or Early Ming dates.)

Workers.—(None; except one visit by Dr. Carl Guthe.)

49. *Panay Island (including Iloilo, Capiz, and Antique Provinces)*:

(This large island, of varied topography and ancient population history, should be one of our richest archaeological fields. Unfortunately, however, it has received but little attention; and, although a number of interesting accidental finds have been made, systematic work has been carried out in only two or three small spots. As with Negros we have also ancient and important historical records to bolster our archaeological findings.)

Tektites and palaeoliths.—Fr. Miguel Selga has examined three small genuine tektites from Panay, all said to have been found in Capiz Province. Several of my students, who have seen our Manila collections, have also told me that such objects are occasionally seen in the fields, in at least two parts of Capiz Province. However, despite repeated promises, I have yet to receive the first genuine specimen.

About 50 small or medium-sized mesoliths, or possible late palaeoliths (mostly of green, orange-yellow, or red-brown cherts), were found by W. S. Boston in the Tigbauan Site (to be hereafter discussed), as well as a few large cores. One much worn obsidian implement was also found there—the first obsidian specimen yet definitely located south of Luzon. (Unfortunately all of this material was destroyed with the Bureau of Science, during the war, and cannot now be reëxamined.)

Neolithic-, Bronze-, and Iron-Age remains.—Neolithic adzes have been repeatedly reported from Panay as "lightning-stones," but I have yet to see the first specimen. No Bronze-Age or early Iron-Age remains have yet been reported, but I have no doubt that they exist there, and would soon be brought out by properly conducted systematic work. (However, see Boston's work at the Tigbauan Site.)

Porcelain-Age and cave remains.—The first reported exploration of Panay burial-caves was on the trip by Merton L. Miller and Luther Parker in December, 1912. Two caves, high up on a cliff near Pilar, Capiz Province, were found to contain carved wooden coffins, more or less disintegrated bones, and considerable ceramic material, mostly Chinese. The big molave coffin (with a carved iguana or crocodile on the cover) for-

merly in the National Museum was obtained here; also a small jar of the 14th or 15th century. Other caves were visited at Dumalag and Dingle, but nothing of importance was found. However, at Dingle (Iloilo Province), two very good large 15th century blue-and-white Ming dragon jars, said to have been excavated from a small mound under a huge ancient *balete* tree, were obtained by Doctor Miller. Each contained a small whole 15th century blue-and-white jarlet inside. (One of the big jars and the two jarlets are still in the Museum collection, the other large jar having been taken to Los Angeles, California, where it probably still is.) Three old pieces of native pottery, said to have been plowed up some 60 years previously in a nearby field, were also obtained.

Reports were also received of other burial-caves at Balasan, on Panay, and on the small Gigantes Islands off the northeast corner of Capiz Province, but these caves were not visited.

Doctor Guthe did not work in Panay, but reports only two accidental finds from individual land-burials, in Iloilo Province.

Jamindan find.—In 1939 the father of Hermogenes N. Martir accidentally uncovered a large 15th century blue-and-white dish of good quality on his farm near Jamindan, Capiz Province. Digging around the place, he found a large 15th century blue-and-white jar, also of good quality. Martir brought the dish to me, but his father still has the jar. (No other pieces were found, but the excavation was perfunctory and the place might well be investigated systematically.)

Antique clay-pipe.—A very interesting and unusually large clay-pipe with decorated bowl, was found in 1935 while an excavation was being made on a hill in Antique Province, and was presented to me by Mr. Fernando Arnaldo, the district engineer. It seems likely to be an 18th century type, but is difficult to date in the absence of associated ceramic specimens.

Boston's Tigbauan finds.—This Site, systematically explored by W. S. Boston while supervising the building of a bridge across the Tigbauan River, in the latter part of 1930 and the beginning of 1931, covers most of a sizable hill known to the local people as "Binayáan." The hill, a little to the east of the town, is from 20 to 25 meters high, and faintly discernible old terrace lines indicate continuous occupation for a long period.

The total collection consists of five whole porcelain pieces, about 350 kilos of ceramic fragments, and a considerable number of miscellaneous specimens—including iron weapons and tools, heavy metallic slag, stone and glass beads, other ornaments, and a small collection of about 50 flaked stone implements.

The chief period of occupation of the site was the 15th and early 16th centuries. There was practically no occupation there after the Spanish arrival. One of the two graves excavated belonged to the 15th century period, but the other is considerably earlier—perhaps 13th century, as it contained a

good Lungchuan dish. A few midden fragments from the earlier period are also found, but it is probable that the occupation then was brief.

The Siamese fragments in the principal midden collection are from 8 to 10 per cent, but they are all of the later types of Sawankhalok wares. The earlier brief period of inhabitation was not only pre-Ming but also pre-Sawankhalok.

It is probable that there are other sites in this vicinity which Boston did not locate; further exploration should be carried over a wider area. More Tigbauan midden material and stone implements should also be gathered, as nearly two-thirds of our collection (including all implements, beads, and other material) was destroyed during the war.

Pre-Spanish Historical Records: The Maragtas.—A remarkable ancient document known as the Maragtas", dating probably from about 1225 A.D., was preserved in Panay and transliterated into romanized Visayan in early Spanish days. Copies exist in the old records of several towns, in all three of the Panayan provinces; and the full text was first put into printed form by Pedro A. Monteclaro, in Iloilo in 1907. (An earlier Spanish version was recorded in Janiuay in 1858 by Fr. Tomas Santaren, and first published in Manila in 1902.) An original in the old syllabary is said to have been taken to Spain in the early 19 h century by a Spanish colonel, but it can no longer be traced.

The document contains a wealth of data on pre-Spanish Panay, and it is undoubtedly the most important single document in early Philippine history. Together with the Pavon manuscripts from Negros, it constitutes a real foundation for the history of the Visayan People in Borneo and the Philippines.

Workers.—(As indicated under the preceding various items.) Also Fr. Angel Perez, Josue Soncuya, Encarnacion Gonzaga, Purificacion Varona, José Celeste, Angel Soncuya, Isabelo de los Reyes, José Maria Pavon, Ramon P. Locsin, Ismael Golez, Tomas L. Mobo, Maria C. Lanzar, Consuelo Picazo, Pacifico R. Palanog, H. Kern, and others. [See also Addendum.]

50. *Cuyo Islands (part of Palawan Province):*

(These ancient inhabited small islands played an important part in Philippine history in the 15th and 16th centuries, and probably earlier. There has been little or no archaeological exploration as yet, but the prospects for future work are good, especially on the main Cuyo Island itself, on Agutaya, and on several of the smaller and more hilly islets. No pre-Porcelain Age material is yet known, and the Porcelain-Age finds have all been accidental without recording of specific sites. I have seen no specimens earlier than the 15th century, but I believe some could be found by proper systematic work.)

Workers.—A. Henry Savage-Landor, Irvin D. Cobb, A. V. H. Hartendorp, Trinidad R. Fernandez, and Patricio Fernandez.

51. *Kalamian Islands, especially Busuanga (part of Palawan Province):* (This group consists of Busuanga, Coron, Culion, and many small islands, originally inhabited chiefly by pagan Tagbanuas. Culion has, since early in the American regime, been set aside as a leper colony—and most of the island is now uninhabited. It would be an ideal place for undisturbed archaeological work, if any proper sites could be located there. It is probable that all of these islands have been anciently inhabited, and more extensive work should be done there in the future.)

Tektites.—Busuanga contains the richest natural tektite sites yet found outside of Luzon. The specimens are deeply sculptured and grooved, and belong mostly to the Billitonite group. (My collection contains about 1,200 good specimens from this Island, mostly found in the "Sandoval" Site, and in the barrio of San Nicolas, Coron municipality. They were acquired chiefly through the good offices of Mrs. Amelia E. Zaldua, Messrs. E. D. Hester and J. Scott McCormick, and the late Representative Claudio Sandoval.) The first Busuanga tektites were collected in 1931 by Teodoro and Mariano P. Maat, of Coron. (Mrs. Zaldua sold a number of Busuanga specimens to the British Museum, and to museums and collectors in Germany, France, and elsewhere. Several American mining engineers, including Churchill Scott and the late A. F. Duggleby, also collected tektites in Busuanga, but the total number outside my own collection is probably less than 200 specimens.)

Stone-, Bronze-, and Iron-Age remains.—None reported as yet, except that some of the material collected by Doctor Guthe from Coron caves may really be of the Iron Age.)

Porcelain-Age and burial-cave remains.—Dr. Carl Guthe explored and excavated two cave-burial sites on the small island of Peñon de Coron, where Edward H. Taylor had previously reported seeing caves containing interesting remains.

The first site is a fissure in the cliffs on the northeastern coast, and the remains had been disturbed by water coming in from the top. Doctor Guthe excavated it, however, and reports the following finds: 5 green, 36 blue-and-white, and 5 overglaze ceramic specimens; 6 pieces of dark jars, and 6 of native ware; 1 iron, 5 copper or bronze, 1 lead, and 2 glass specimens; 1 stone, 6 shell, 1 bead, 4 skeletal, and 4 miscellaneous; or 83 specimens in all. (This seems to indicate a middle or late Ming site.)

The second site is a cave on the northwestern coast, and was explored by Doctor Guthe personally. The contents consisted almost entirely of highly ornamented and irregularly shaped vessels of native pottery. The following specimens are listed: 1 fragment each of green and blue-and-white porcelain; 86 pieces of native ware; 1 iron, 2 glass, and 4 shell specimens; and 3 skeletal remains; or 98 specimens in all. (Two periods; one possibly Iron Age.)

For further note on the Kalamian Islands burial-caves, see Addendum.

Workers.—(As indicated under the preceding various items.) Also A. Henry Savage-Landor, Dr. H. W. Wade, and others.

52. *Palawan Island (including Balabak, Dumaran, Linapakan, and other neighboring small islands (part of Palawan Province):*

(This area covers the greatest superficial territory of any Philippine geographical unit, being stretched out for several hundred miles. There has been no systematic archaeological exploration in any part of the area, owing partly to isolation and difficulty of transportation. Doctor Guthe explored several caves near the northwest corner of the main Island, but gives no account of the results. It is known that there have been a considerable number of accidental excavations of land-burials containing porcelain and other ceramic pieces, but most of this material is still in the hands of the native farmers. Mr. E. D. Hester has been the chief collector of such pieces, having obtained altogether over 200 good pre-Spanish ceramic specimens from two Palawan areas which will be discussed briefly below.

No tektites or pre-Porcelain-Age material of any sort have been reported from Palawan proper; but it seems very probable that such material might be turned up by systematic work, especially in certain specific areas known to have been long inhabited. It should be regarded as a favorable field for future work whenever opportunity offers.)

Porcelain-Age finds: Malampaya Sound area.—One good middle or late Ming dish of the polychrome overglaze decorated type was obtained by Mr. Hester from Captain Wallace, who formerly operated a lumber concession in the Malampaya Sound area. It was excavated by one of his workmen in a kaiñgin; but three other pieces obtained in the same area turned out to be 18th century blue-and-whites, and were probably merely preserved among the neighboring Tagbanuas as heirlooms.

Hester's Collection from Uling-uling.—On two visits, in April 1933 and in 1935, Mr. Hester obtained a total of 192 good pre-Spanish ceramic pieces, all accidentally excavated in the Uling-uling (or Oring-oring) district of southeastern Palawan. Of these, about 40 pieces are certainly of Sawankhalok or other Southeast Asia origin, while the remainder are all or mostly Chinese.

About half-a-dozen pieces seem to have come from a middle or late Sung burial-site in the vicinity; but the great majority of the specimens, however, are Early Ming pieces of the 14th and 15th centuries, and were all excavated by the pagan and recently Mohammedanized Tagbanuas of the vicinity in their new clearings and lately developed farmlands. Panglima Kalampisi greatly aided Mr. Hester in finding and collecting these pieces, and seemed to take considerable personal interest and pride in seeing that they were preserved for scientific purposes.

The late Capt. F. G. Roth also obtained a few similar pieces from the Uling-uling area, which were later transferred to the Hester Collection. (The entire original Hester Collection, with the exception of the specimens from Sulu and Pampanga, was placed on loan at the Chicago Museum of Natural History early in 1938, and thus escaped the wartime destruction that so seriously affected the collections remaining in Manila.)

Historical possibilities.—The first European writer to call attention to the survival among the pagan Tagbanuas of one of the ancient pre-Spanish syllabaries was Alfred Marche, in his interesting volume entitled "Lucon et Palaouan" (Paris, 1887), where the greater part of Chapter XV is devoted to the subject (quoting Alphonse Pinart).

In later times Manuel Hugo Venturello, Norberto Romualdez, Ignacio Villamor, and Fletcher Gardner have discussed this subject more fully; while at the present time Harold C. Conklin is engaged in a systematic study of both the language and writing. (A number of lengthy Tagbanua bamboo manuscripts formerly existing in the National Museum were destroyed during the war; but copies of most of them survive in my collection.)

Although no inscriptions on stone have yet been located, either in Palawan or in Mindoro, it seems possible that proper archaeological exploration in the areas where this old writing still survives might be productive of important results. (In any case, other survivals from pre-Spanish culture and possessions should certainly be located.)

Workers.—(As indicated under the preceding items.) Also Edward Y. Miller, Eli A. Helmick, Dean C. Worcester, H. O. Beyer, and others.

53. *Cagayan Sulu Island (part of Sulu Province):*

(This small island in the central Sulu Sea has been an important trade center from very remote times. However, no pre-Porcelain-Age remains have been definitely reported; but the ceramic finds go back to the Late Tang period. Doctor Guthe reports a site there, but gives no hint of its contents. Most of the later finds are in the Hester Collection or in that of Mrs. Caroline Spencer at Indanan, Sulu.)

Porcelain-Age finds.—The oldest material from Cagayan Sulu came from the accidental excavation of one or two graves on the hill nearest the wharf at the town of Cagayan Sulu itself, in May, 1933. Mr. Hester obtained (through Lieutenant Arpa) three of the whole pieces excavated, while two others went to the collection of Mrs. Spencer at Indanan. These five pieces date between the 9th and 11th centuries, being either Late Tang or beginning Sung, and rank among the oldest class of porcelains found in the Philippines. About a month later Lieutenant Arpa sent Mr. Hester two other Sung pieces said to have been excavated on the same hill, together with a number of other pieces from a second locality of much later date.

The second site, from which two other pieces were obtained in August, 1934, is a short distance inland from the first hill, and all of the material found appears to be Early Ming and Sawankhalok wares, of the 14th and 15th centuries.

Mrs. Spencer's Collection is said to contain a number of other good pieces found on this Island prior to 1932, but without site indication. F. G. Roth told me that there were several early Indo-China (Thanh-hoa) pieces among the lot, but I have not personally examined them. (A complete systematic exploration of the Island should undoubtedly be carried out, if opportunity offers.)

Workers.—(As indicated above.) Also Antonio Pigafetta, and F. H. Guillemard.

54. *Camiguin Island (part of Oriental Misamis Province):*

(Although I visited this Island in 1921 and saw some very interesting Early Ming grave-pieces that were presented to W. Cameron Forbes by Mrs. Reyes, of Mambajao, during our visit there, I was unable to return for a further exploration of the sites as we then planned. The actual collecting on the Island, since that time, has been mostly done by Orville M. Babcock for his own collection, and by Generoso Maceda for the National Museum. No pre-Porcelain-Age material has been reported.)

Porcelain-Age remains.—Babcock's specimens from this Island number not less than 40 or 50, and include several rare or unique pieces. Maceda obtained over a dozen whole pieces, and a considerable quantity of fragments, chiefly from the grave sites. Two or three old sites were reëxamined, and one new site discovered. (Doctor Guthe marked one grave-site on this island, but did not indicate the contents.)

All of the Babcock and Maceda material is dated between the 14th and early 16th centuries (chiefly Chinese 15th century blue-and-white, with a small percentage of Sawankhalok wares), and consists almost entirely of small pieces. Jarlets, tea-pots, water-vessels, covered round and square boxes, and the like, predominate. Several rare or unique shapes and decorative designs are found. (It is probable that other good sites could be found by systematic work.)

Workers.—(As indicated above.)

D. MINDANAO AND THE SULU ARCHIPELAGO (WITH PARTS OF NORTH BORNEO AND CELEBES)

55. *Agusan Province:*

(A considerable part of this province is swampy and not favorable for archaeological work, although very favorable for the preservation of archaeological material. Nevertheless, there are some solid and hilly areas where collecting is favorable, and two of the most important Philippine finds have been made in this Province. No systematic work has been done, and no tektites or palaeoliths have ever been reported.)

Neolithic finds.—The first Neolithic stone implement to be scientifically reported from the Philippines came from Agusan, This was found by Dr. Karl Semper in 1859 or 1860, being carried as a charm-stone by a Manobo of the Agusan Valley. (Jagor's Camarines Sur Neolithic adze was found in 1860, and may possibly have been first. Both he and Semper deserve equal credit for the first Philippine stone implement finds, although Semper's data were first published.)

Two other Neolithic implements were found among the Manobos by John M. Garvan, during his ethnological work there, about 1910. The people regard them as stones thrown by the god "Anitan" in his wrath, when men have angered him.

Bronze- and Iron-Age remains.—(None positively reported as yet.)

Porcelain-Age finds and survivals.—Doctor Guthe did not visit Agusan Province, and furnishes no data on it. The Hester Collection contains two good pieces from Agusan, both of which came from Novela, in the Gibung district, in 1933. The first specimen is a good Chinese small blue-and-white vase or large jarlet, with a peculiar modified hole-bottom base. It is evidently 15th or early 16th century in date.

The second piece (obtained through Mr. Goco, of Butuan) is said to have definitely washed out of a caving riverbank at Novela. It is a large stoneware jar, with small archaic dragons high up near the neck, and appears to be a Yuan production of the 14th century or earlier.

No other actual pre-Spanish ceramic sites are known to me, although accidental finds of grave-porcelains are reported from near Cabadbaran.

Protohistoric and historic finds and records.—The most spectacular single find yet made in Philippine archaeology is that of the famous "Agusan Gold Image" (now preserved in the "gold room" of the Chicago Museum of Natural History), which appears to date from the 14th century or earlier. It was actually found in 1917, projecting from the silt in a ravine (following a storm and flood), on the left bank of the Wawa River near Esperanza. It was found by a woman who had entered the ravine, after the storm; and from her hands it passed into those of Blas Baklagon, a local official. He brought it to me in 1918, and I had it carefully photographed, measured, and tested at the Bureau of Science. As the bullion value exceeded 4,000 pesos (at the old rate), I tried to get the Government to purchase it for the National Museum, but funds were not available. Shortly after this, ownership of the image passed to the Agusan Coconut Company, to whom Baklagon owed a considerable debt. Finally, through the interest of Mrs. Leonard Wood, funds were found for its purchase by the Chicago Museum.

A study of this image was made by Dr. F. D. K. Bosch, of Batavia, in 1920, who came to the conclusion that it was made by local workmen in Mindanao, copying a Ngandjuk image of

the early Madjapahit period—except that the local artist overlooked the distinguishing attribute held in the hand. It probably had some connection with the Javanese miners who are known to have been mining gold in the Agusan-Surigao area in the middle or late 14th century. The image is apparently that of a Sivaite goddess, and fits in well with the name "Butuan" (signifying "phallus"). Pigafetta's account of the court of the "King of Butuan," whom he visited at Magellan's behest in 1521, bears this out—as the non-Mohammedan King of Butuan was apparently a survival from the old Madjapahit colony of a century earlier.

John M. Garvan further states that the Manobo chiefs knew of this image long ago; that one of their number kept it secretly hidden as a priceless *pusaka* (sacred heirloom) for an unknown number of generations; that it had been lost during a great flood which destroyed several villages during the late 19th century, and the guardians moved away to another district with a view to escaping the vengeance that they feared their ancestral spirits might wreak on them; and that after its re-discovery in 1917 they were afraid to claim it again. (The probable truth of this story is strongly supported by the number of bronze Sivaite and Buddhist images found by the early Jesuit Fathers among the Mandayas; the Siva image from Cebu; and other similar finds.)

Important historical and cultural data on northern and eastern Mindanao are given in Pigafetta's narrative; they should be correlated with the accounts of the first Spanish visitors to the region.

Workers.—(As indicated under the preceding various items.) Also Escolastico G. Zapanta, W. C. Bryant, J. Montano, Edward H. Taylor, Santiago S. Calo, and others.

56. *Surigao Province (including Dinagat, Siargao, and other smaller islands):*

Tektites.—Although Mr. Victor E. Lednicky states that Wallace E. Pratt and himself found a considerable number of tektites many years ago in placer workings and in cultivated fields in Surigao Province, I was never able to obtain any specimens or confirmation until 1936. On May 1 of that year Mr. G. M. Goodall found a single genuine tektite among the remains in a burial-cave on the small island in front of Port Lamon. (This cave will be discussed in a later paragraph.) The tektite was undoubtedly carried as a charm-stone by the Porcelain-Age folk who used the cave, but it may well have been originally found in a nearby part of Surigao Province.

(No Stone-Age or other pre-Porcelain-Age specimens are positively known from Surigao—although Neolithic adzes have been verbally reported as being seen there.)

Burial-cave explorations, and Porcelain-Age remains in general.—One of the earliest mentions of burial-caves in Surigao is in the 1910–1912 notes of John M. Garvan, who describes a

cave called "Tinago," located near the barrio or sitio of Tagaáan, Placer municipality. He saw here broken wooden coffins, skeletal material in various states of preservation, and quantities of ceramic fragments, but made no attempt to collect any of them. He also mentions another cave, containing similar material, seen near Lake Mainit. (Doctor Guthe, to whom I gave Garvan's notes, visited these caves about 1923.)

Doctor Guthe's table indicates seven caves and one land-burial, or a total of eight sites explored in Surigao. He describes the first area ("Dinago," as he writes it) as follows: Three caves, located within a few yards of one another, on the small island of Dinago just north of Placer. First visited by Dean C. Worcester, and later by Doctor Guthe. Remains of coffins were seen. The following 85 specimens were collected: 11 green, 1 grey, and 2 brown ceramic fragments, plus 15 blue-and-white and 3 black-and-white; 1 piece of a dark jar, and 1 of unglazed stoneware; 12 fragments or pieces of native pottery; 5 objects of iron, 3 of copper or bronze, and 8 of shell; 5 beads; 7 skeletal specimens; and 11 miscellaneous.

Cadwallader Collection.—One of the best private collections that I have seen from the Surigao region was that formerly in the possession of the late B. W. Cadwallader (probably destroyed during the war). These specimens were collected from several different sources while he was engaged in lumbering and mining activities along the Surigao coast. Most of them were of Early or Middle Ming date, and the total ran up to nearly 200 pieces—many specimens and photographs being brought to me for identification. All specimens seen range between the 14th and 16th century, including a few celadons and a few Sawankhalok black-and-white pieces but mostly being Chinese blue-and-whites and polychromes. (Unfortunately no accurate list of sites was kept; and, although Mr. Cadwallader had promised to give me a copy of his notes on localities, and on other items he died before this was done.)

Beyer and Hester Collections.—Both my own and Mr. Hester's collections contain important Surigao material. These will be listed by lots or sites, without any particular arrangement—those in my General Philippine Collection coming first:

Gigaquit (Higákit) cave material.—This lot consists of 54 broken porcelain pieces and fragments, all collected from an old cave (said to have been partially uncovered during the great earthquake of 1923) in the Botong district of the barrio of Nuevo Campo Superior, Gigaquit municipality. They were collected by Justino Prañada, a Manila student formerly employed by Mr. Hester, in the latter part of 1937. He was told about the cave by a Mamanua Negrito, who said that he had found two whole ceramic pieces there after the earthquake; but when Prañada visited it only fragments remained. (The location is between 8 and 9 miles inland from Gigaquit, in an area formerly inhabited only by a mixture of Mamanuas and Manobos.)

The collection is important for the ceramic history of northeastern Mindanao, and consists of the following specimens: 2 pieces of a large 15th century brown-glazed dragon-jar; 2 pieces of a big black-and-white Sukhotai dish (14th century); 4 pieces of a very large blue-and-white "red-bottomed" dish (14th or 15th century); 5 fragments from two Early Ming polychrome pieces (probably 15th century); and 35 fragments of Chinese blue-and-white wares, chiefly of 15th century types including "hole-bottom" pieces, and good examples of "Mohammedan blue," and other objects). A few fragments may possibly be early 16th century.

Goodall Site at Port Lamon.—A small burial-cave, located on Bagasinan Island just in front of Port Lamon, was explored by G. M. Goodall on May 1, 1936, and a small but excellent collection sent in for my General Philippine Collection. The decayed and broken remains of a number of wooden coffins were not collected, as well as part of the skeletal material. Some of the best specimens were obtained through excavation of such soil as remained on the cave floor. The following material was sent in: 3 human skulls (one artificially flattened), 12 loose teeth, and a small boxful of human and animal bones and bone fragments; 2 large stone implements of unusual types (post-Neolithic); 5 pieces and fragments of iron weapons and tools; 21 pieces of bronze, brass, and similar metals (including one whole and two broken bracelets, 6 arm-ornaments, 3 discoidal breast-ornaments, 2 small bells, and 7 brass ornaments probably originally from the handles or scabbards of weapons); 2 gold ornaments (incised disks from the ends of ear-plugs); 1 whole and 2 fragmentary shell bracelets; 1 broken tortoise-shell bracelet; 1 perforated spiral shell ornament (perhaps used as an ear or neck pendant); 3 other ornamental objects of shell or bone (one unique); 150 small disk-beads or sequins made from mother-of-pearl; 47 glass, shell, and stone beads of various sizes, colors, and types; 1 whole clay-pipe bowl of an interesting and unusual type; and 1 broken tektite showing very deep grooving (probably used as a charm). Also four small boxes filled with porcelain and stoneware fragments and one with native pottery.

The ceramic fragments and the ornamental objects both indicate two distinct periods in the use of this cave for burial purposes; and the ceramic wares alone probably indicate three periods. The earliest period, represented by a relatively small proportion of the material, is 13th and 14th century; the second period, comprising the bulk of the collection, is late 14th and 15th centuries; while the third group is basically 16th century. On one side of the cave there was even a small group of typical 18th century fragments, indicating a brief period of later use, probably as a shrine (but possibly as a pirate hideout for 18th century loot, as local tradition indicates). At least three unique types are found among the ceramic wares;

and two of the metal ornaments are of designs not yet known from any other Philippine site.

C. M. Peters' finds at Placer.—In January, 1937, a single small limestone island, a little less than two kilometers north of Placer, was carefully explored by Mr. Peters who brought in only a few objects found in the recesses of the cave, but did not disturb the bulk of the material. There is only one cave on this island, about 18 to 20 meters deep and located only two meters above normal sea-level. The 21 specimens brought in are of unusual interest, and listed briefly as follows: 1 decorated clay-pipe bowl, of a Sumatran or Malaccan type; 6 large and small pieces of iron dagger-blades and knives; 2 large mother-of-pearl ornaments of an unusual spoon-shaped type; 10 fragments of decorated common pottery (all from either two or three pots), all of Kuta Tinggi or Sumatran types; 1 piece of a large Southeast-Asia blue-and-white dish; and 1 large section of a typical "red-bottomed" black-and-white bowl. Not a single Chinese specimen appears in this lot, all of the materials appearing to be of Southeast Asia origin. And all of the datable specimens appear to be of the 15th century or earlier.

If possible, this cave should be re-visited and a larger collection made. The only possible conclusion from Peters' material is that the cave was utilized chiefly by voyagers from Sumatra or the Malay Peninsula in the early Mohammedan period prior to the Spanish arrival.

Hester Collection Sites in Surigao Province.—Five different sites or site-areas are represented among the Hester specimens from Surigao Province, described briefly as follows:

(*1*) *Mahanub barrio find.*—A medium-large celadon bowl, of a pre-Ming Chinese type, was accidentally excavated on a hill farm in Mahanub barrio, Gigaquit municipality, in 1932; and was brought to Mr. Hester by Pedro Odtójan. In 1934 Pedro again brought a good Early Ming blue-and-white dish, found in an adjoining field, and still later two old jars from the barrio. (This would seem to be an attractive place for systematic work, as at least two periods are indicated and all finds so far made have been accidental.)

(*2*) *Tabon-tabon burial-cave.*—In July, 1934, Tomas and Regino Pareja brought to Mr. Hester eight good ceramic pieces (five celadon and three blue-and-white) which had been found in a newly opened burial niche or cave at Tabon-tabon, eastern Surigao. Two of the specimens are very interesting bulb-bowls or censers, each with three feet, a rare type in Philippine burial sites. (Common, however, in the graves of Fukien and other central and south China provinces.) All pieces of Yuan and Early Ming dates.

(*3*) *Tandag-Tago district finds.*—This area contains a number of good sites where accidental finds have been made, both in caves and rock-niches along the coast and in land-burials

on inland farms and kaiñgins. In May and June, 1935, Mr. Hester obtained a total of 12 good ceramic pieces from this district, through Tomas Pareja and Gregorio Plaza—of which four are celadons, six Chinese blue-and-white, one plain white, and one an overglaze polychrome. The full range is 13th to 15th century, some burials being likely Yuan, while a majority are Early Ming. (This whole district merits systematic exploration.)

(*4*) *San Isidro barrio find.*—A large dragon-jar of very early type (with two archaic five-toed dragons high up near the ears), with a dark-grey stoneware body, and with six rather unusual lion's-head ears, was excavated by a farmer named Florencio Calgo in one of his fields in San Isidro barrio, Gigaquit municipality. It was obtained by Mr. Hester in 1935.

This specimen is probably Yuan in date, and may be even earlier than the 14th century. It is unfortunate that no other pieces were found with it, to give a clue to contemporary dating.

(*5*) *Villafranca barrio find.*—In 1937 a farmer named Liborio Paña accidentally unearthed a large light olive-green Sawankhalok (or Sukhotai?) celadon dish, of an early type, in one of his fields in the sitio called Hagnajá'an, in Villafranca barrio, Gigaquit municipality. This specimen was brought in to Mr. Hester on October 3, 1937, by Justino Prañada, who had visited the place where it was found but failed to locate any other pieces. (The date of this dish is certainly 14th century or earlier, and it probably indicates a Yuan or Early Ming burial site in the vicinity.)

The above items, together with those cited on previous pages, indicate that many of the barrios of Gigaquit municipality are filled with ancient burials of several types, and that the whole area presents rich possibilities for future systematic work. (As with many similar areas, it is important that something be done about this before too much of the material is dispersed or destroyed through further accidental or unscientific excavations.)

Workers.—(As indicated under the preceding various items.) Also J. Montano, L. D. Lockwood, Montano A. Ortiz, various Jesuit missionaries, and others. (See Addendum for further Surigao data.)

57. *Davao Province:*

Early Palaeolithic remains.—Although no tektites or Pleistocene mammalian fossils have yet been reported, the oldest Philippine palaeoliths found south of Luzon have come from this province. In March, 1936, the late Capt. F. G. Roth found in a sand-heap near the edge of Davao town two very interesting early palaeoliths—practically identical both in material and workmanship with the Trinil-type palaeoliths in the Rizal-Bulakan Collection, and with those found by G. H. R. von Koenigswald at Sañgiran village in Central Java. The sand and gravel pits from which the original material had come were located by

Captain Roth, but no competent geologist was able to examine them before the outbreak of the war.

Neolithic finds.—Two middle Neolithic stone adzes, found somewhere in Davao Province about 1902 by the late Governor Orville M. Wood, were presented to my collection in 1918 by his widow—and are both specimens of exceptional interest (although no record of the original site was found among Governor Wood's papers). Said to have been found near the Davao-Cotabato border-line.

One of the adzes is made of schist, and appears to have been an Early Neolithic specimen reworked into a Middle Neolithic semitanged type. The second adze is of a well-polished dense green stone (probably an altered rhyolite), and of a tanged semiridged type, distinctly ancestral to the Polynesian forms. (This tends to confirm the previously expressed view that the southern Philippines was the jumping-off place for at least one of the principal Polynesian migrations.)

Bronze- and Iron-Age remains.—(None yet definitely reported; but there are cultural survivals of both among some of the pagan Indonesian peoples of the Province. For cave remains found on Samal Island, see No. 58 below.) The two bronze images from the Caraga River Valley are almost certainly of the Porcelain Age (to be discussed below).

Porcelain-Age finds and collections.—Prior to the war two important porcelain collections existed in Davao—belonging to F. G. Roth and Ernest H. Oesch (all or mostly destroyed during the war, and both owners now deceased). The Roth Collections contained relatively few specimens from Davao Province—most of them having been acquired in Sulu, Cotabato, Cebu, and Luzon; but the Oesch Collection contained many specimens (mostly broken) from Davao sites, although the greater number of whole specimens were obtained from the Dulawan area of Cotabato Province (to be discussed under No. 60, below). The Oesch sites will be discussed hereafter.

The earliest finds from Davao Province were made by the Jesuit missionaries, and were sent to the museum of the old Ateneo de Manila. In addition to a number of skulls (several artificially deformed), Ming jars, and other ceramic specimens, from caves and burial-niches along the east coast, there were two famous bronze images found carefully guarded as sacred heirlooms (*pusaka*) among the pagan Mandayas of the upper Caraga River. One of these images, standing about 8 inches high and having many arms, seemed definitely Sivaite or Brahmanistic, while the other one appeared to belong to the Buddhistic pantheon. They were both undoubtedly brought to the Philippines in pre-Spanish and probably pre-Mohammedan times—while Madjapahit or the earlier Sri-Vishayan influence was still strong here. (Both the images and the other specimens mentioned were destroyed through the burning of the Ateneo Museum; but the images had been carefully sketched,

measured, and described by Dr. G. P. Rouffaer in 1912, and were again examined by myself and Dr. P. V. van Stein Callenfels in 1928–1929.)

Oesch sites and accidental finds.—From the following three Davao Province sites Oesch obtained a few whole pieces, many broken ones, and sherds: (1) A burial site on the beach, near the foot of Mt. Piapi, about 5 to 6 kilometers south of the mouth of the Padada River. (2) A burial site, said to have been used by the Kalagan Manobos in early Spanish times and before, located about 1 kilometer south of the mouth of the Padada River. (3) An ancient burial-ground, also said to have been used by the pagan Bilaans in early Spanish times, located about 10 kilometers up the Padada River, near the river bank. (No Bilaans have lived in this area within the memory of any one now living, and the site is deeply covered by river silt. Several whole pieces of both imported and native ceramic wares were found here by probing in the earth with a long wooden rod, and then digging them out. No systematic excavation was done.)

Most of Oesch's other Davao pieces came from accidental finds (including several good jars and celadon dishes, as well as a number of small blue-and-white pieces), of which no accurate record was kept. He gave me the following summary of his total collection on April 22, 1940: Total, about 400 pieces, of which over half were small Ming pieces (jarlets, bottles, saucers, covered round and square boxes, etc.); 12 to 15 Sung pieces, mostly celadon (two large and the remainder small); a few large and small jars; and a few Ming overglaze polychrome wares. The remainder are mostly Sawankhalok or other Southeast Asia wares (including a few doubtful or modern pieces).

The above totals include both Davao and Cotabato pieces. The destruction of this collection was a real loss to Philippine ceramic history.

Cultural survivals.—As Christian and Mohammedan influences scarcely touched the Davao region until the 19th century, much pre-Spanish culture survived unchanged until quite recent times. The letters and papers of the early Jesuit missionaries, and the cultural studies by Laura E. W. Benedict, John M. Garvan, Fay Cooper Cole, Mabel Cook Cole, the Metcalf sisters, and others, are full of details of interest for pre-Spanish studies. The early contacts of eastern Mindanao were chiefly with Celebes, Java, and other Indonesian islands, rather than with Borneo and Indo-China—and this manifests itself in the surviving cultures. (However, a strong Chinese influence, coming down from the north, is also apparent.)

Workers.—(As indicated under the preceding various items.) Also Mateo Gisbert, J. Montano, A. Henry Savage-Landor, Warren D. Smith, Benichi Setogawa, Levi E. Case, F. Maxey, and others.

58. *Samal Island (in Davao Gulf; part of Davao Province):*

(While no pre-Porcelain-Age remains have yet been reported from this island, or from the adjacent smaller ones, four interesting burial-caves were explored there in 1882 by Dr. Alexander Schadenberg, and some other important observations made. In 1924 Doctor Guthe re-visited one of these caves, at the southern end of the main island, but has published no data as to the result. The late Capt. F. G. Roth in August, 1931, found another small cave on the adjoining Malinpanao Island, and reported that a considerable quantity of porcelain fragments was seen there, and in certain rock-crevices and crannies on the same small island. Owing to the circumstances of his trip, he was able to bring back with him only one sample specimen—a half-whole Chinese blue-and-white bowl of the middle or late 16th century.

The whole area is worth systematic exploration, for historic and other reasons. The present population is curious, seeming to consist of an ancient mixture of bearded Europeans with a rather unique native stock. It seems probable that Dutch or other European vessels may have been wrecked there several centuries ago.

(The Schadenberg finds will be discussed more fully below; and additional Samal Island data will be found in the Addendum.)

Schadenberg's 1882 exploration.—In addition to 23 skulls (of which nine were artificially deformed cave-skulls) and other skeletal specimens, Doctor Schadenberg collected about 60 ceramic specimens, of which 16 pieces are illustrated. Eight of the latter appear to be native pottery vessels with incised decoration. Two large dragon-jars are of very early types (Yuan or Early Ming); while one probable celadon jarlet is of about the same date, or a little earlier. The remaining five illustrated specimens are of uncertain date, but probably all pre-Spanish. (Of the skulls, five are illustrated in four positions each, in very clear and detailed reproduction.)

In addition to human and animal bones, and ceramic specimens, Schadenberg found iron weapons and tools (considerably disintegrated), of which spearheads, arrowpoints, axes, and various shapes of small knives are mentioned. Also both bronze and shell bracelets, in several of the caves.

Workers.—(As indicated in the preceding items.) Also A. B. Meyer, A. Henry Savage-Landor, Frederick H. Sawyer, and the Jesuit Fathers.

59. *Sarangani and Balut Islands (part of Davao Province):*

(No pre-Porcelain-Age remains found; but these islands are important historically, and were visited by several early voyagers. In 1543 the Villalobos expedition remained here for six months, planting and harvesting a crop of maize to replenish their food supply.)

Porcelain-Age remains and survivals.—In August, 1924, I personally examined an interesting old burial-site on the northwestern side of Balut Island, located near the western projecting point of the island. In company with William Crosby, of the Bureau of Forestry, I examined an area located at the edge of a secondary forest growth and a grass-covered hillside, facing the sea, about half a kilometer inland and some 50 to 60 meters above sea-level—the whole region having long been completely uninhabited. Here we found a curious burial-mound, one side of which had been partly broken down by erosion. Having no excavating tools with us at the time, we were forced to be content with what we could dig out with our hands and a couple of sharpened sticks. In this manner we obtained three nearly whole ceramic pieces, the accompanying bones being so completely disintegrated that we did not attempt to save them. The first piece was a thick-glazed light green celadon, and the second an early blue-and-white ware, both apparently of the 15th or early 16th century. The third piece, however, although probably of contemporary date, was of still greater interest, being a native pot of grey-black bodyware with the outside half-covered with an incised or impressed design.

The only other object recovered from this mound was an iron dagger-blade or small spearhead, so badly weathered that it fell apart in laminated rust-flakes when we tried to remove it. About half of the mound was left unexcavated, as we were called back to the ship. Two or three other similar mounds, apparently undisturbed, were seen in the vicinity—and this area is certainly worth systematic excavation when opportunity offers. The burial mounds are low oblongs, quite reminiscent of certain Indian burials, that I knew as a boy in the Mississippi River Valley in eastern Iowa, but rarely found in other parts of the Philippines.

Workers.—(As above.) For historical data, see Blair & Robertson, F. D. Burdett, and others.

60. *Cotabato Province:*

(This province is the largest in the Philippines, in point of actual land area; and many accidental archaeological finds have been made in widely separated parts of it. No tektites or pre-Neolithic remains have turned up; but Neolithic finds have been made in at least two areas and Porcelain-Age sites are numerous, while Bronze- and Iron-Age survivals indicate the strong probability that sites of those periods would soon be found if systematic work were carried out. Historically and protohistorically, Moro records go back into late pre-Spanish times, while still earlier relations with the old empires of Madjapahit and Sri Vishaya are known from partial records, tradition, and cultural survivals. Four pagan, two Mohammedan, and several Christian groups are represented among the present population; and the Province is a fertile field for future systematic work, both archaeological and ethnographic.)

Neolithic finds.—In 1909 Emerson B. Christie obtained five Neolithic stone adzes and chisels while making an ethnological collection among the pagan Tirurais of west-central Cotabato Province. Three of them, which remained in the National Museum, were lost during the war; but two of them had been transferred to my General Philippine Collection, and are still on exhibit at the Institute. My present recollection is that two or three were Early Neolithic adzes reworked in Middle or Late Neolithic times; while the other two were of plain-backed Late Neolithic type. One specimen of each type still survives.

One of the Christie specimens (still at the Institute) is deeply patinated, indicating recent excavation; but the other four were more or less polished, and had been found by him in the hands of native priests or magicians who regarded them as potent charms. He states that they were called "dila latik," or "lightning tongues."

While the late Governor James R. Fugate was living at Upi, also in the edge of the Tirurai country, in 1938, he sent to me and to F. G. Roth several Neolithic specimens found in the Awang district. The two that I still have are a rather rough Late Neolithic adze (from Upi), and a remarkable whole specimen of an extra-large horned barkcloth beater. The latter specimen was found at Nuro by Fermin Padua, while he was digging postholes for his new house. It was buried about two feet below the surface, in a reddish soil. The specimen is thickly patinated, and appears to be of Middle or early Late Neolithic type. It is quite similar in form (but larger and thinner) to the only other known Mindanao barkcloth beater—the famous "Ateneo" specimen from Misamis Province (see No. 62).

Porcelain-Age finds and explored sites.—In 1920 Edward H. Taylor found a small burial site in the forest, between 7 and 8 kilometers back of the Celebes Plantation Company's office on the Cotabato southwest coast. The site lies in the Tagabili country, where the people fear old burial places and are careful not to disturb them in any way. Taylor found numerous broken ceramic pieces of interesting pre-Spanish types, disintegrated iron weapons and tools, ornamental objects, and skeletal material, washing out of partly broken down mound-burials—quite similar to those found by Crosby and myself on Balut Island (see No. 59 above). Owing to the nature of his trip, Taylor removed only one nearly whole skull and a few ceramic fragments, and left the site otherwise undisturbed.

Doctor Guthe did not work in Cotabato Province, and lists only two indefinite finds there; and the Hester Collection lacks any old Cotabato specimens. Aside from my own fairly large collection, I know of only three other lots of Cotabato material—the Roth and Oesch collections in Davao, and the Rafael Roces Collection in Manila, all of which were destroyed during the war. The Roces lot will be discussed hereafter, under Bu-

kidnon Province, as most of it probably came from there or just over the Cotabato borderline. The Roth specimens, like many in my own General Philippine Collection, were from accidental finds without definite site records. More than half of the Oesch specimens listed on p. 308 above (particularly the blue-and-whites and overglaze polychromes) came from the Dulawan area of Cotabato. They were mostly obtained for him by a Moro collector, and came chiefly from accidental finds without specific records, some pieces having already been put to use in Moro homes. The great number of pieces found, however, indicates that the Dulawan area is rich in old burial sites and heirlooms, and would be a profitable place for systematic work.

The Saceda collecting trip of 1933.—The best Cotabato specimens in my General Philippine Collection were the result of a special trip made to the northern and central parts of the Province by my Visayan Islands collector, Crisogono Saceda, in 1933. While visiting a Cebuano friend at Pagaluñgan Agricultural Colony No. 5 (near Fort Pikit) he heard of a piece of porcelain being dug up in one of the fields. With the aid of his friend and a few other Cebuano settlers, he conducted a fairly extensive excavation there, securing altogether 19 whole ceramic pieces and fragments of several others, from a single large field. No true midden site was located, as the surrounding fields were not properly searched; but I have no doubt that one could have been located somewhere in the vicinity by a trained observer.

The date range of the 19 whole pieces found at Pagaluñgan covers less than a century—late 15th to middle 16th—and they correspond very closely to what we call the "Inálsan type" in Rizal Province. The following specimens were brought in: 7 Chinese blue-and-white of Middle Ming types, 6 Chinese Middle Ming monochromes, 3 Sawankhalok black-and-white covered bowls or round boxes, 1 special white dish of Fukien "Tehwa" ware, and 2 unusual small dishes of South China or Indo-China wares. Two of the Sawankhalok covered bowls are the largest yet found in the Philippines; and the Fukien dish was the first unbroken specimen of this type found, although fragments are known from several sites and the National Museum formerly had a similar piece from an unknown Visayan Islands site (broken during the war). No beads, bracelets, or other ornaments were found; and the iron tools and weapons were so completely disintegrated in transit that they could not be reconstructed.

The Liguásan finds.—While on this same trip, Saceda also obtained ten other good ceramic pieces and four metal specimens from three sites in the Liguásan area of north-central Cotabato. The first and oldest lot consists of five pure Sung ceramic pieces (four celadons and one small four-eared jar cov-

ered with incised floral designs), of the 12th century or earlier, all probably excavated from one or two adjoining graves. This is the first pure Sung burial-site yet reported from Cotabato.

The second Liguásan lot consists of two perfect Chinese blue-and-white bowls of medium size, one of which originally had on the outside of the bowl an added overglaze design in the usual Early and Middle Ming three colors (tomato-red, yellow, and turquoise-green). Both pieces are of good Ching-techen porcelain, and have factory marks or "hall-marks" on the base, while the inside blue-and-white designs are mostly of boys at play, or other human figures. These bowls are both of types illustrated in R. L. Hobson's "Wares of the Ming Dynasty" as being Early Ming of the first half or middle of the 15th century; but our Philippine experience, especially in the Rizal Province and Manila sites, leads us to believe that they are not earlier than the late 15th or early 16th century. In fact, these two pieces would be placed by me as of the same general date as the material from the Pagaluñgan Site (discussed above), and as probably coming from a contemporary grave.

The third and last Liguásan lot consists of three ceramic and four metal specimens obtained from a Moro who claimed to have excavated them a year or two previously in one of his fields. The ceramic pieces are all very interesting, and seem to probably represent an early 14th century site contemporary with the late Yuan period—although none of the specimens are regular Chinese wares. One is a tall Sawankhalok celadon jarlet, with a rather opaque bluish-green glaze, an early type of pre-Satchanalai manufacture. The second piece is a bowl of the special "red-bottomed" type. While the third and last ceramic specimen is a finely crackled saucer-dish, with a thin greenish-brown glaze—probably of 13th or 14th century Thanh-hoa or South China manufacture. The four metal specimens are said to have been found in the same field with the ceramics. One is a bronze cup, partly filled with lime; while the other three are of iron (a medium-large spear-head, and two perforated balls that seem to have been either spindle or drill weights.) This area should be further investigated in the future.

Historical records and survivals.—The famous collection of original Moro manuscripts made by the late Dr. N. M. Saleeby is wholly gone, part having been burned with his house in 1909, and the remainder destroyed with the Bureau of Science during the war. My own facsimile copies of some of the more important Saleeby MSS. were also destroyed at 212 Nebraska during the war. Of those originals still preserved by old families, in Cotabato Province itself, the war saw the end of many but it is hoped that a considerable number still survive.

One of the best collections was in the hands of Representative Gumbay Piang, at the beginning of the war.

Typewritten copies of many ancient Moro records still exist in my 10-volume "Moro Ethnographic Series"; but more should be diligently sought while originals or copies still survive. Special attention should be paid to the records both of the old Sultanate of Magindanao and to those of the up-river "Radja of Buwayan"—political states which go well back into pre-Spanish times.

Workers.—(As indicated under the preceding various items.) Also Thomas Forrest, Jacinto Juanmartí, José Tenorio (a) Sigayan, Guillermo Bennásar, F. H. Sawyer, A. Henry Savage-Landor, E. B. Christie, J. Montano, Ralph S. Porter, F. C. Cole, Mabel C. Cole, Wm. C. Bryant, Charles E. Livingstone, Datu Piang, Datu Sinsuat, Frank J. Dunleavy, Martin Ortuoste, William E. W. McKinley, H. O. Beyer, Frank W. Carpenter, Capt. I. B. Edwards, and others.

62. *Bukidnon Province:*

(No tektites or pre-Porcelain-Age archaeological finds definitely reported, although it is possible that the interesting barkcloth beater discussed under Misamis Province may have actually been found in what is now Bukidnon territory. The early Jesuit Fathers referred to the Bukidnon people as "Monteses" and had dealings with them from a very early period. Search should be made in the writings of Colin, Combés, and others, for data on early finds, customs, and pre-Spanish survivals.)

Porcelain-Age finds and survivals.—Two inland caves were explored by Dr. Carl Guthe about 1923, but he gives no data as to the results. They may be the same caves explored at a still earlier date by Dean C. Worcester—of which a number of interesting photographs formerly existed in the Bureau of Science Collection. The photographs, of which I have still some prints, clearly indicate good quality broken ceramic wares of the 15th and 16th centuries only. The location of these caves is somewhere near Maluko, not far from the Misamis-Bukidnon road.

In May, 1933, E. D. Hester obtained four large stoneware jars from Bukidnons living along the roadway from Maluko to Malaybalay. Two proved to be Spanish-period pieces of the 18th century; but the other two are interesting middle or Late Ming pieces of the 16th or beginning 17th centuries. They are probably true heirloom pieces preserved among the Bukidnons as ceremonial wine-jars, in the same manner as the numerous old jars of the Mountain Province peoples.

Roces Ranch finds.—Some of the finest ceramic pieces obtained from the entire Central Mindanao area have been found on or near the Roces cattle ranch, along the Bukidnon-Cotabato borderline. A good many of the pieces were accidentally excavated by workmen on the ranch, or by local settlers in

the vicinity, and they were collected for Rafael Roces and some of his friends by the ranch foreman. I examined most of these pieces in Manila in 1932, for Mr. Roces, who then had the intention of presenting two or three of the best specimens to Governor-General Theodore Roosevelt, who was about to leave the Philippines. The pieces retained by Mr. Roces were all destroyed during the war, although some few specimens in the hands of other persons may have survived.

My examination indicated that the material from this area is all Late Yuan and very Early Ming, no piece being earlier than the 14th century, and none later than the middle 15th. One very fine large blue-and-white dish (14 inches wide) was of the special "red-bottomed" type; while another (nearly 16 inches wide) was covered with a strangely unique design under a thick greenish and bubbly glaze. I believe that both of these special types are of the 14th century. (The number and character of the pieces found indicate that this whole area should be systematically explored in the future. It lies in the upper Pulangi River Valley, about 50 kilometers north of Fort Pikit, Cotabato Province, from which area very similar material has already been described.)

Workers.—(As indicated in the preceding items.) Also Manuel Fortich, W. F. Hale, W. C. Bryant, John M. Garvan, Ricardo C. Galang, José Sanvictores, Mabel Cook Cole, and others.

62. *Misamis Province (old boundaries): (now Oriental and Occidental Misamis Provinces, excluding Camiguin Island):*

(Eastern Misamis, or Misamis proper, is a narrow coastal strip lying between the sea and the northern edge of the Bukidnon plateau. In our present study, western Misamis will be considered as covering only the narrow coastal strip lying to the west of Iligan and Panguil Bays. For political reasons, large sections of the thinly inhabited mountain hinterland, lying back of the coastal strips, have recently been transferred from Bukidnon and Zamboanga to Oriental and Occidental Misamis; but ethnographically and archaeologically they still belong to the original provinces, and will be so considered in the present paper. The Dapitan-Dipolog district will also be considered under Zamboanga Province, for historical reasons; although, having long been populated by Visayans, their transfer to Western Misamis is more justifiable.)

Stone-Age remains.—No tektites or certain pre-Neolithic finds have been recorded, the flint microliths found by Fr. Ewing being probably Neolithic in point of actual manufacture, although resembling Mesolithic forms.

The oldest Neolithic find was made in eastern Misamis, and dates back to April 14, 1889, when Procopio Alcantara presented to the museum of the old Ateneo de Manila a remarkably perfect specimen of a Middle or Late Neolithic horned barkcloth beater, which he stated to have been found in use as

an idol or sacred image among the pagan Bukidnons of the Tagoloan area. He stated further that they called it *Tigbas,* and believed that it had fallen from the sky.

This instrument is a combination beater and printer, and I had it carefully photographed in four positions and measured, in the early 1920s. This was fortunate, as the specimen was later lost in the Ateneo fire. The material was a porphyrytic andesite.

At least two other finds of Neolithic adzes have been reported by University students coming from eastern Misamis, but I have not been able to examine either specimen.

Metal-Age survivals.—The presence of certain curious beads and other ornaments among the pagan Subanuns in the mountains of western Misamis was reported to me prior to 1918 by Emeterio Roa and other University students, and later a few specimens were brought to Manila. Unfortunately, all of this material was destroyed during the war, but if my recollection is correct there were several important Iron-Age types among the lot. The Subanuns believed that they had fallen from the sky—which usually means that they were found washing out from ancient burial places on traditionally uninhabited hill-sides.

Porcelain-Age finds and survivals.—Doctor Guthe did no work in Misamis proper, his only important find having been on Camiguin Island. The Hester Collection also has no pieces from Misamis Province.

My General Philippine Collection has several fairly good pieces from western Misamis, but all except one important find are lacking in site data. The one known site is in a small barrio just back of Jimenez, from which I have one good 15th century blue-and-white jar. This area must contain a number of burials, as more than 20 ceramic pieces are said to have been excavated there (a majority of which were 15th and 16th century blue-and whites). Most of the specimens went into the hands of private collectors in either Cebu or Zamboanga; and it is likely that the greater part of them were destroyed during the war. The original finds were made in 1932.

Shortly before the war I received some notes from my former student and collector, Pedro Abella, relating to an interesting new find of some 15 or more pre-Spanish ceramic pieces and other specimens made near the southern border of Misamis Occidental. The letter contained details of the site, and other data, but it has either been lost or mislaid during the war period and cannot now be located. (If found, the data will be included in the Appendix to the present paper.)

Workers.—(As indicated in the preceding items.) Also Ramon J. Capistrano, José V. Neri, Fr. J. Franklin Ewing, Fr. Jaime Neri, former Senators Artadi and Ozamis, and Manuel Fortich.

63. *Lanao Province:*

(No pre-Porcelain-Age remains actually found, but Bronze- and Iron-Age survivals numerous, indicating strong probability that sites could be located if systematically searched for. Porcelain-Age remains numerous, but most finds so far purely accidental. As with Magindanao, historical records of the Lake Lanao region go back well into pre-Spanish times. The area is referred to in 14th century records as *Malano*, and it was one of the strong seats of Madjapahit culture. The region has highly developed metal-working art that shows much evidence of contact with Java, Sumatra, and India; while certain other culture features indicate ancient Chinese and Japanese influences. The defensive armor of the Lanao warrior shows a notable mixture of Japanese influence with 16th century Spanish; and other interesting similar items might be noted.)

Porcelain-Age finds and heirloom survivals.—Doctor Guthe did no work in Lanao; but the Hester Collection, the Babcock and Hugo Miller Collections, and my own General Philippine Collection all contain a considerable number of Lanao specimens—both from accidental excavations, and in the way of heirloom specimens. Those that I have seen are mostly 15th and 16th century Chinese blue-and-whites, with a few overglazed polychromes, and a fair number of the later Sawankhalok wares from the Satchanalai kilns. In addition to ceramic specimens, there are a number of gold, silver, and bronze buckles, pendants, rings, and other ornamental objects, some of which may be pre-Spanish; particularly in my own collection (but many were stolen during the war).

The only midden site yet reported is one found in June, 1928, by Ifor B. Powell, just back of the cotta of the Sultan of Mulundu. Most of the midden fragments brought in are early Spanish period, but from 10 to 15 per cent are pre-Spanish and seem to indicate an old settlement in this vicinity.

One interesting feature of the Lanao Middle Ming porcelains is the presence of an unusually large number of pieces with "fish-scale" or "dragon-scale" designs in a rich dark violet-blue, apparently all of the Chia Ching period. The correspondence with the Inalsan Site in Rizal Province is quite notable.

Historical records of pre-Spanish date.—The genealogies and other documents in Dr. N. M. Saleeby's "Moro Studies," and certain Spanish documents reproduced in my "Moro Ethnographic Series" or cited by Colin or Combes (Pastells and Retana editions, respectively), contain important data on early Lanao history. (Additional material of this sort should be sought in Lanao, if any is still obtainable.)

Workers.—(As indicated in the preceding items.) Also A. Henry Savage-Landor, F. H. Sawyer, Dean C. Worcester, Charles Winslow Elliott, H. O. Beyer, Frank C. Laubach, Hila-

rio Moncado, G. V. Sumner, Jr., H. Hossfeld, Superintendent Kuder, and others.

64. *Zamboanga Peninsula and Province (excluding Basilan Island):*

Stone-Age remains.—No tektites or other pre-Neolithic finds, except a considerable number of microliths located by Frs. J. Franklin Ewing and Jaime Neri, and these seem most likely to be of Neolithic manufacture although possibly Mesolithic. All of this material was destroyed during the war, in 1942, except one flint microlith sent me as a sample by Fr. Ewing in 1941. The latter wrote me that obsidian microliths had been found—but if the sample sent was representative the material was actually translucent flint. (So far, no obsidian has been found south of Luzon, except a single specimen from Panay which may have been transported.)

While studying the Subanuns in 1909–1910, Emerson B. Christie found several Late Neolithic adzes and chisels in use as charms by the medicine-men, chiefly in the Sindañgan Bay area. One of these specimens is still in the Institute Collection, while two others were destroyed at the Bureau of Science during the war—but I still have photographs of all of them. One has been damaged by subsequent use as a sharpening stone, but all are clearly plain-backed forms of well-known early Late Neolithic types.

Bronze- and Iron-Age survivals.—No actual finds of Bronze- or Iron-Age sites have been reported, but many important survivals of these cultures exist among both the Moros and the pagan Subanuns— and it is probable that sites could be found by systematic search. (Fr. Ewing found what he considered to be a possible Iron-Age site somewhere back of Sindañgan Bay; but as both specimens and notes were lost during the war, and as I saw none of the material, nothing further can be included here.)

Porcelain-Age finds and survivals, in general.—Many finds have been made in the Zamboanga Peninsula during the past half century, some by trained explorers and others accidentally. The more extensive finds have been made in four principal areas, which will later be discussed separately: (*a*) the Dapitan-Dipolog area at the northern corner of the Peninsula; (*b*) the narrow part of the Peninsula, a little to the north of Zamboanga City; (*c*) the Sindañgan Bay region; and (*d*) the Margosatubig-Malangas region.

In addition to the above four areas, accidental finds have been made in a number of places, but concerning most of them we have no adequate records. Miners working placer deposits have found interesting gold beads, of the same types as the 12th century finds at Paracale and in the Shauger Site in Samar, in at least two localities. The site notes and one photograph were lost during the war, but the gold beads were mostly taken to the United States by two of the American miners employed on the work.

Dr. Carl Guthe lists five caves, five burial-grounds, six individual land-burials or graves, and eight miscellaneous or doubtful sites, explored under his direction in Zamboanga and Basilan combined, but gives no further data on the Zamboanga finds. (The full records are doubtless in the Michigan Museum.) His Basilan finds will be discussed under No. 65 below.

Frederick L. Worcester, of Zamboanga, prior to the war possessed a very fine collection of celadons and other pre-Spanish ceramic pieces, a number of which were found in the Zamboanga Peninsula—although a majority came from Sulu, Cebu, and elsewhere. Most of the collection was destroyed or looted during the war, and no records remain of the original sites, where known. His finds on Basilan will be discussed later.

The Hester Collection contains no specimens from either Zamboanga or Basilan, and my General Philippine Collection contains only a few, without significant data.

(*a*) *Finds in the Dapitan-Dipolog area.*—The first to explore the burial-caves and land-burials of the Dapitan area were Fr. Francisco Sanchez and Dr. José Rizal, during the latter's exile there, in 1894. Among other objects, some interesting gold jewelry of the 14th or 15th century (wrongly interpreted as early Christian) was excavated on a hill reputed to be haunted by spirits of the ancient inhabitants. One of the rings (illustrated by Craig) is almost identical with the San Felipe Neri and Ormoc specimens previously described.

However, the first systematic examination of this area was carried out in 1906 (February-April) by Emerson B. Christie, for the old Division of Ethnology and Philippine Museum. Altogether, he examined some 18 different caves and burial-places, at several localities in the Dapitan and Ilaya districts; and brought together the most extensive archaeological collection ever made in the Philippines prior to 1922—except for the work of Marche in Marinduque in 1881. In 1922 I gave Dr. Carl Guthe a copy of Christie's detailed report, and during the following two years he re-visited a number of the principal caves, etc., and removed a considerable part of the material that Christie had not taken. Some of the sites were again visited in 1940–1941 by Frs. Ewing and Neri, but little was left to remove.

Christie's collections were all deposited in the old Philippine Museum, and contained a great variety of material including a number of very interesting gold ornaments. Some of the large black burial-jars and fragments are still left in the National Museum, but the greater part of the collection (including all of the ornaments and smaller specimens) was destroyed or lost during the war. No photographs exist, except of some of the jars. However, I examined all of it, at various times in the past, and can say definitely that at least 95 per cent of the material was of the 14th and 15th centuries, and the earliest specimens

found were of Yuan date. Some good Sawankhalok and Southeast Asia ceramic pieces existed, although at least 80 per cent of the ceramic material was of Chinese origin. No finer black burial-jars have since been obtained from any other locality. A considerable number of metal objects existed—mostly iron weapons and tools, but including also objects of copper, bronze, brass, lead, and other material, as well as gold and silver ornaments. Only a few beads were found but some are of interesting types.

The following specific sites are described in Christie's report:

(1) A small cave on the lower slopes of the hill which rises just to the north of Dapitan; contained only bones, much disintegrated.

(2) A cave on the lower slopes of the hill called Limanon, about 6 miles from No. 1; containing a great quantity of ceramic fragments, jars, etc., as well as some skeletal material and many filed teeth.

(3) A small cave adjoining No. 2, and an excavated talus slope both gave interesting results; additional ceramic material, broken shell bracelets, and metal objects (including two arrowheads) were found.

(4) A large midden site on top of Limanon hill; much ceramic material found (both imported porcelains and native pottery), resembling that from the caves.

(5) A burial-cave in the sheer face of the cliff facing toward Dapitan, on Limanon hill. (Christie failed to get into it, but Doctor Guthe successfully explored it in 1923–1924.)

(6) A small burial-cave about 20 minutes walk from the barrio of Ilaya; bones, ceramic fragments, and one cylindrical gold bead were found.

(7) A rock-shelter, a few meters away from No. 6, also contained bones, pottery, etc. The hill where these two sites are is called "Tapalun" by the natives.

(8) A large hill called "Cataluñgan", located about 45 minutes canoe-trip down the river from Ilaya, and 1½ to 2 hours climb inland by footpath; contains several empty caves near the foot of the hill, and a large burial-cave several meters above the ground in the face of a steep cliff. This cave contained four or five large burial jars with one or more pieces broken out of the sides, and one of them was half filled with skeletal material. Many loose bones were scattered about the floor of the cave. A great number of stone, shell, and tortoise-shell bracelets were found; also a small round gold ornament and two gold caps for ear-plugs. Pottery fragments were very scarce, and no iron tools or weapons were seen. There were at least 50 to 60 burials in this cave. Thirty of the best skulls were collected and shipped to Manila, with the most perfect

burial-jar and a considerable number of the bracelets and other objects. The cave was very dry.

(9) An old burial-site at a place called "Marinhit," in the Lubuñgan area, reached from Dapitan by banca up the Dicayo River; one burial-cave at a place called "Tambay" on a creek of the same name; and three caves, all in one hill, up the Siraan River which flows into the Dicayo.

In one of the Siraan caves a round gold ornament was found; also a considerable number of jars and plates, a few of the latter being whole. Also many shell bracelets, etc. Only a few specimens from the Siraan caves were taken for shipment to Manila.

(10) On the banks of the river above Duhinot, and of a small tributary, no less than five old burial places were found—four being caves and one a rock-shelter or shelf in the face of a cliff. A number of large carnelian and agate beads, and two gold ornaments, were found in one of these caves; and there was a great quantity of ceramic fragments in all of them. One jar was found still containing human remains and beads inside. It was ornamented with a dragon design.

(11) At Manukan, just beyond Punta Blanca, and within sound of the waves, a medium-sized cave was found containing a layer of ceramic fragments more than a foot deep, as well as many bones, etc. Little or nothing was taken from this cave, as the contents seemed similar to what had been already collected.

(12) Several burial-caves were heard of, some distance up the Disacan, or Lisacan, River; but Christie failed to find them, as a recent smallpox epidemic in the vicinity had frightened the people and no guide would accompany him.

(13) A cave on the Tangyan branch of the Disacan River was visited, but found to be empty.

(14) Other caves were heard of in the Langatian subdistrict, but time was not available to visit any of them.

Altogether, seven good gold ornaments were obtained on this trip. They included cylindrical beads, ring-money, incised earplug covers, and other objects. It is unfortunate that no proper photographs or drawings were made of them before they were lost—but they were all of types since found in other Philippine burial-sites, although the detail of the designs may have been different. (Jesuit Fathers Obach and Jose España assisted Christie with information.)

(*b*) *The area north of Zamboanga City.*—The first good-sized collection from southern Zamboanga was secured for the old Philippine Museum through the interest of Governor Frank W. Carpenter and the late Juan Posadas, Jr., in 1919.

The site was an apparently undisturbed burial-cave, first discovered by accident in the latter part of May, 1919, in the sitio of Manga, Bolong barrio, about 7 kilometers from the seacoast. The cave was in a limestone hill, covered with trees and bushes, and the opening was about 30 feet above the surrounding flat land. The cave is very large, being nearly 200 feet deep, with two main chambers and a thick layer of clay soil in the bottom; part of the specimens found being excavated from this clay floor.

The original discovery was made by Pedro and Felipe Tarroza, and a certain Rafael de Leon—Pedro's house being only about 300 meters from the site. According to Mr. Posadas' investigation, the following objects were found in the cave: 3 glazed burial-jars, 6 small plates and saucers, 1 bowl, 1 porcelain tea-pot or water-vessel, 1 lot of beads (originally apparently all on one string), 1 piece of flat gold wire about ½ inch wide and a foot long, and a number of broken pieces of porcelain and pottery, and several whole and broken shell bracelets. Later investigation and partial excavation by Mr. Posadas brought to light 3 more large jars, 1 small jar, 6 pieces of broken jars, 1 white stone artifact, and 2 pieces of copper or bronze. (Posadas' work was on July 24, 1919.)

None of the beads, bracelets, or gold wire, and four of the original small plates or saucers, could be located by Mr. Posadas, as they had already been disposed of by the finders before his arrival. All of the other objects were shipped to the Philippine Museum at Manila, through Governor Carpenter. The original cave and two others that were found in Bolong barrio were ordered sealed by Mr. Posadas, to await further investigation by a competent man from Manila, but, so far as I am aware, the investigation was never carried out.

Most of these specimens were destroyed at the Bureau of Science during the war, but I still have photographs and descriptions of all the important ones. The full range of the site is from the late 13th to the early 15th century. Most of the jars and porcelain pieces are very Early Ming, but at least three of the jars are of a curious type with incised designs that seems to be definitely of Indo-China make (northern Annam?) in the 13the or 14th century. The fine celadon bowl and the two small blue-and-white plates (all found in perfect condition) are probably of the 14th century, or beginning 15th at the latest; and this seems a fair estimate for most of the other objects found in the site.

The two bronze specimens are undoubtedly much corroded pieces of a large gong, and may have been used as a cover for one of the burial-jars, in the same fashion as found in several Basilan Island sites (see No. 65).

(c) *The Sindañgan Bay region.*—During 1940–1941 Frs. J. Franklin Ewing and Jaime Neri explored a very interesting group of burial-caves in the region around Sindañgan Bay.

Collections were made from four of the caves, and shipped to Manila, but all were destroyed during the war, including, most unfortunately, all site records and field-labels as well. Fr. Ewing's own notes were also lost in Mindanao, as well as the additional collections which he had stored there (chiefly in Dipolog and Cagayan de Misamis). I had examined all of the collections sent to Manila, however; but in the absence of the field-notes cannot now give the location of the caves. My notes on the first three caves were lost, and can only be restored partially from memory. The fourth cave, in a sitio called "Baluk," was explored at a later date; and, fortunately, I kept an extra copy of the notes at the Institute, and thus will be able to describe it in some detail, below.

As to the first three caves, I can only say that the remains consisted chiefly of a large and excellent collection of skeletal material associated with numerous large fragments of black and dark-brown burial-jars, very similar to those obtained by Christie from the Dapitan and Ilaya caves. Some porcelain pieces and fragments, ranging from the 14th to the 16th century and chiefly of Chinese manufacture, were also found, in addition to a number of much corroded iron weapons and tools, and a few miscellaneous objects. No gold or other metal ornaments, and only a few beads and broken shell ornaments, were found in the first three caves.

The Baluk Site.—Although my notes do not contain the exact location of this important fourth cave, it is known to lie several kilometers inland from Sindañgan Bay. In addition to a considerable collection of skeletal material, the following other objects were obtained: 3 flat gold disks, with incised designs, being caps from the ends of horn or hard-wood earplugs; 4 carnelian and 11 glass or paste beads of various sizes and colors (nine of which were found with gold disks); 3 whole and 1 half-whole bronze or copper bracelets; 14 whole shell bracelets (of four standard types and three sizes); 1 package of fragments of iron weapons and tools (representing at least six different specimens of different shapes); 19 packages or pieces of black and brown glazed jar fragments (each from a different jar), all of Middle Ming types; 1 nearly whole Sawankhalok black-and-white round box, of a probable late 15th or early 16th century type; and 15 pieces and large fragments of Chinese porcelain wares, all of late 15th or early 16th century types.

The obvious general conclusion from the above data is that the Baluk cave was chiefly used for burial purposes in the late 15th and early 16th centuries.

(*d*) *The Malangas-Margosatubig region.* In 1919 Mr. A. V. H. Hartendorp collected a number of specimens for me around the Margosatubig area, and in 1921 I personally collected midden fragments from three different sites near the Malangas coal mines, and near where the small mine railroad comes down to the landing-pier on the coast. All of these speci-

mens, including the field-labels and notes, were destroyed at 217 Nebraska during the war. My present recollection is that practically all of the ceramic specimens were of Middle and Late Ming types; and I am quite certain that there were no pre-Ming specimens of any sort.

Workers.—(As indicated under the preceding various items.) Also Carl M. Moore, J. Scott McCormick, Henry Neibert, Datu Dakula, F. P. Williamson, C. J. T. Clarke, N. M. Saleeby, Awkasa Sampang, J. H. Hackett, and others.

65. *Basilan Island (part of Zamboanga Province):*

Stone-Age remains.—Doctor Guthe's collection contained one plain-backed early Late Neolithic adze, about 3 inches long and 1⅝ inches wide, made of a dark-grey slatelike material, found on Basilan. I have an accurate sketch of this specimen, which he sent to me in November, 1924.

No other Stone-Age material from this Island has yet been reported.

Possible Bronze- and Iron-Age survivals.—No actual finds of identifiable Metal-Age artifacts have been made, but interesting survivals among the Yakan Moros indicated that systematic search might very likely turn up true Bronze- or Iron-Age sites. Certain old beads and other ornamental objects especially are of types that seem to go back at least to the Middle or Late Iron Age.

Porcelain-Age sites and accidental finds.—The oldest known Basilan site is that discovered through accidental excavation, in 1920, while a canal was being dug on the northwest side of the Island. The chief find was an extra-large glazed burial-jar, of an unusual type, standing about a meter in height and ⅔ meter in width. It was excavated from a depth of over a meter under the ground, and when found was covered by a large broken bronze gong or drum-head of a much-corroded and very early type. Several small ceramic pieces, some beads and other jewelry, and a number of fragments of much-disintegrated bones were found inside the jar—but were all carried away by the workmen. The jar and gong were examined by me in Jolo, and were later acquired for the National Museum. The jar is a probable South China production, not later than the first half of the Ming period and could be older. The gong is probably a Sulu production of a still earlier date.

Doctor Guthe's finds.—While Doctor Guthe explored several Basilan sites, he has given us a description of only one. This is described as a large burial-ground on the small island just off the southeastern point of Basilan. It was first visited by Dean C. Worcester, and later twice explored by Doctor Guthe. Most of the specimens were obtained from the inhabitants of a village which now occupies the site—the specimens having been turned up in the course of house-building, gardening, and farming. The following material was derived from this site: 29 green, 8 grey, and 6 white ceramic pieces; 7 brown-glazed pieces; 78 blue-and-white, 11 black-and-white, and 8 decorated

overglaze polychrome pieces; 45 dark-glazed jars; 1 unglazed stoneware, and 5 pieces of native pottery; 3 specimens of copper or bronze, and 1 of lead; 6 beads, 1 stone specimen, and 4 of shell; 1 bone specimen, and 3 miscellaneous; or 217 specimens in all.

The general conclusion from the above list is that the site is basically 15th and 16th century, unless the monochromes and Sawankhalok black-and-white wares show 14th century types or earlier. This question can only be properly answered by examining the original material, now in the Michigan University Museum, or by visiting the site itself. It is obvious, from the quantity of material obtained, that a very large burial-ground exists in this locality—and it is probable that many other specimens could be obtained there by systematic search.

F. L. Worcester's finds.—While the Frederick L. Worcester Collection, in Zamboanga before the war, contained a number of interesting pieces resulting from the accidental finds on Basilan, it was not until 1937 that he found an actual undisturbed site there. Having had his attention directed to certain accidental finds at Bohelebung, he set about exploring the immediate vicinity by a combined process of probing and excavation. A small midden-site was also located in the area, and a package of specimens sent to me at Manila for study and identification. By preliminary probing in the sand, several small whole pieces (all Chinese and native wares of the 16th century) were located and excavated; and at last, in April–May of that year, a complete jar-burial of an unusually good type was found. A full account of the excavation was sent to me by Mr. Worcester, and at a later date the complete contents of the jar-burial was determined to be late 16th or beginning 17th century; but its contents were rather unusual, and are worthy of a brief description: one tall Middle Ming burial-jar, with six ears, and having an agong as cover; one medium-large polychrome plate of the Chia Ching period, dating between 1530 and 1550; one blue-and-white medium-sized plate, with an ogee edge and a deer-pattern, of the Chia Ching period, c.1540-1550; one blue-and-white medium-large bowl of the Wan Li period, c.1580–1600; one small greyish-white dish, Wan Li type, c.1580-1600; three bronze, or brass jingle-bells; four copper and base-metal rings; four corroded and acid-etched shell bracelets; two human teeth and one small toe-bone (other bones being completely pulverized); seven Chinese copper, bronze, and brass cash (all Ming; three having identifiable dates as Hung Wu, Yung Lo, and Chia Ching); and finally a large quantity of glass, stone, and metal beads, probably originally forming one or two necklaces and two bead-bracelets. Among the metal beads several were gold, of very interesting types—one being a decorated cylinder, and the others round.

When the jar was unpacked, the following order of contents was found: The four dishes were nested together on top,

directly under the agong cover; and next came two skulls and a great mixture of partly pulverized bone-fragments. The bottom third was filled with sand, in which the beads, bracelets, bells, and other small objects were found imbedded.

Two other similar jars were unearthed by Panglima Jalaha—all of them being apparently of contemporary date, and being buried fairly close together. One of the Jalaha jars also contained gold beads, as well as glass and stone ones of the same types as those in the Worcester jar. It is obvious that these burials were made around the end of the 16th century, but before any European influence had affected the area. It is unfortunate that the contents of the Worcester jar were not properly photographed or sketched, as some of the bead types were quite unique, and it is believed that all were destroyed or looted during the war. All that now survives is a small but good photograph of the jar itself, and the agong cover, sent to me by Mr. Worcester in June, 1937, at the time I examined the contents. (The site should be further explored.)

Workers.—(As indicated in the preceding items.) Also N. M. Saleeby, John H. Whitaker, D. C. Beebe, J. R. Mahoney, Pedro Cuevas, H. O. Beyer, William Crosby, Francis L. Link, and others.

66. *Jolo (or Sulu) Island (part of Sulu Province) including Pañgutaran, Pata. Capual, etc.):*

(The Sulu Sultanate historically includes three principal parts: 1. Sulu Island proper—called Sulug or Su'ug by the Moros, and known to the Spaniards as Xolo or Jolo—which is the subject of the present section, including several adjacent smaller islands. 2. The remainder of the Sulu Archipelago, to be considered under No. 67, below. 3. The greater part of British North Borneo, anciently known as the "Kingdom of Saba"; to be considered under No. 68, below.

The earliest Philippine historical and protohistorical records yet known come from Sulu, and go back at least to the 10th century if not before. However, the Island has frequently been devastated by bitter wars, and ancient records have been destroyed time and again—and it is here that historical archaeology plays a most important part in restoring lost data. Something has been done already, along these lines, but there is room for a great deal more of systematic work and patient research, which as yet has been carried out only very sporadically.)

Stone-Age remains—No pre-Neolithic material has yet been reported. Neolithic adzes have been seen by Link and Taylor in possession of several Moros, in the interior of Sulu Island. An extra-large adze made of polished black hornrock or fine-grained basalt, measuring about 10 inches long by 3½ inches wide at the blade, was examined and sketched by John M. Garvan on Pañgutaran Island in April, 1924. It was in the possession of a certain Abdur-Rajak, who was residing in the

house of Maharajah Laping of Pañgutaran. Laping states that it is a true "lightning tongue," and was originally found at the foot of a tree from which the bark had been stripped by lightning. He further states that on Jolo Island there are other similar specimens, but of different sizes, shapes, and colors.

This Pañgutaran specimen is normal except for two projecting knobs, one on each side of the butt, like some Chinese jade-adzes that I have seen. While this shape is well-known from certain early Chinese sites, this is the only specimen yet known from the Philippines.

Bronze- and Iron-Age survivals.—No true Bronze-Age or Early Iron-Age sites have yet been located in Sulu, but it is believed that systematic work would uncover such sites. Cultural survivals in certain areas are very definite, pointing toward the original existence of such cultures in the Island. Late Iron-Age remains have been found by Roth, in certain areas, mixed with the earliest Porcelain-Age remains. It is also possible that a true Iron-Age site, unmixed with later remains, exists near the former Constabulary barracks in Jolo town. These remains will all be discussed in connection with our review of Porcelain-Age sites. The late Capt. F. G. Roth carried out the most systematic work yet attempted on Jolo Island, but his activities were limited by administrative duties and the lack of properly trained assistants.

Porcelain-Age sites and collections.—The earliest and largest ceramic collection in Sulu prior to the war was that belonging to Mrs. Caroline S. Spencer and kept in her home at Indanan. It is believed to have either been entirely destroyed or carried away by looters during the war. The original collection consisted of several hundred pieces, of which nearly half were excavated pre-Spanish grave-pieces while the remainder were mostly heirloom specimens of Spanish-period dates, obtained from Moro homes. A considerable part of the collection was made prior to 1920, and practically all of it prior to 1932; but Mrs. Spencer kept few records except dates and the names of the persons from whom she obtained her material. Utilizing this list, Captain Roth in 1934 was able to recover much of the original site-data—and this will be incorporated in the discussion of the sites which he himself explored.

Doctor Guthe's collection from Sulu was made for him by the Panglima Sabudin, working under the direction of F. L. Worcester, including some material from other Moro collectors. The records kept were subject to the usual limitations of this kind of collecting. Most of the specimens were obtained by a house to house search in the interior of the Island; and the total collected is listed as follows: 45 green, 16 grey, 9 white, and 24 brown monochrome pieces; 23 blue-and-white, 7 black-and-white, and 6 overglaze decorated polychrome pieces; 20 dark-glazed stoneware jars; and 14 miscellaneous ceramic pieces (mostly modern); 1 iron, 4 copper or brass, and 1 glass; or a total of 170 specimens in all.

The Hester Collection contains a few general specimens from Jolo Island (partly obtained from Mrs. Spencer) with site-data—recorded as follows: 1 Sawankhalok jarlet of bluish-green celadon (14th century), a gift from Mrs. Spencer, originally found, with several other good specimens, in an accidentally excavated 14th or 15th century pre-Islamic grave near Bilaan, Jolo Island, in 1931, and 5 other ceramic pieces, from various parts of Jolo Island, without trustworthy site records.

The Roth Sites.—Altogether 16 specific sites were explored on Jolo Island by the late Capt. F. G. Roth in 1934–1935, or were found by one of his assistants at a later date (as indicated in the text). The field-work was all done by Captain Roth and his assistants, with the aid of oral and written suggestions from myself; a considerable part of the expense was paid by Mr. E. D. Hester, who received a number of the whole pieces found; while the working up of the entire collection was carried out by me, and the midden material and most of the nonceramic artifacts were deposited in the University collection. The characteristics of the 16 sites will be listed separately, in brief form, as follows:

Sulu Site 1.—An area known as "Sapa Lawakan," running along both sides of the Taglibi-Tiptipon Road, near Km. 21. The road cuts through a rather extensive burial-ground, which first drew attention to the site. Later, extensive midden deposits were found also. A large collection was made, consisting of whole and broken ceramic pieces from the burial-site; many iron weapons and tools; one iron coin of the special Sulu type (see Site 9); a few ornamental objects; some interesting decorated native pottery; and, finally, a large quantity of midden fragments of many varieties. Conclusions from the story told by the material found are as follows: The site was first occupied by a 13th and 14th century village and burial-ground, which came to a complete end with the entry of Islam in the early 15th century. After an interval of a generation or two, a new and larger village grew within the area, in the 15th and 16th centuries, which village apparently received no Siamese or Indo-China wares at all, probably due to being dominated by a Mohammedan culture-group. (For location of all Jolo Island sites, see fig. 2.)

Sulu Site 2.—This site, also found during the construction of the Taglibi-Tiptipon Road, is located between Km. 24 and 25 in front of the place known as "Bud Timbuk"; and it is located on a gently sloping hillside, a short distance from a fine natural spring in a ravine. A midden deposit was first cut into, at a depth between a half and one meter, where a layer of common red pottery mixed with a few 15th century porcelain fragments begins. Some late Sawankhalok fragments were present, but no

black-and-white wares of the Sukhotai type. Graves were next cut into, and three whole pieces (all of the 14th or beginning 15th century) in the Hester Collection came from there. One is a typical Sawankhalok celadon bowl, one a good "red-bottomed" piece, and the other a 14th century Yuan saucer. A nearby field was found to contain a village midden of somewhat later date—basically late 15th and early 16th century. Thus this area contained two ancient villages—one pre-Islam and the other of the Mohammedan period.

Sulu Sites 3 and 4.—Site 3, or "Bud Kapok," and Site 4, known as "Timaho" or "Tubig-Timaho," are either very close together or possibly may be essentially the same site. Roth obtained a number of good pieces from the site itself, and also a number of good pieces from the same area acquired through Mrs. Spencer. The area is located about half a kilometer from the beach between Tandu-Pugad and Siunugan. The pieces were originally accidentally excavated by Ambutu Balu and Hassan of Tarawi, while planting bananas, before Roth visited the site. The total number of pieces from this area is very considerable—the Hester Collection having 27 pieces, Roth 3, and myself 15 damaged pieces. Of the total of 45, 24 are definitely Chinese, 11 Indo-China, 6 Sawankhalok, and 4 of uncertain provenance. Among Mrs. Spencer's specimens from this area, at least half are of Indo-China wares. The great majority are pretty definitely of the 13th and the 14th century; but there is a small group of the late 15th and early 16th century Chinese wares that seem to clearly indicate that one part of the site contains a burial-ground of later date than the original large village of Yuan times. The later and small village was of the Mohammedan period.

Sulu Sites 5 and 6.—Site 5, "Luas," and Site 6, "Labuan," are both located on the area known as "Tuan Usman's Farm," and can best be discussed together—although the two sites differ in date and characteristics of the material. Site 5 is definitely of the Mohammedan period, containing beautiful Ming thick-glazed celadons, blue-and-white wares, and typical Middle Ming jar-fragments, with no Siamese or other Southeast Asia wares at all. On the other hand, Site 6 contains mostly Yuan and very early Ming wares, plus two Indo-China and three early Sawankhalok celadons, all of pre-Islamic types and dates. However, it is of the last phase of the pre-Islamic period which contains the iron coins of the early 15th century, since some of these are definitely present (see notes on Site 9).

Sulu Site 7.—This interesting site, known as "Laum Sua," includes two areas called "Sakilan's Farm" and "Ohad's Farm." In some ways this area differs from all other

Sulu sites; but this seems at least partly due to its having been occupied longer and more continuously than most of the others. Some 12 whole or nearly whole pieces were obtained here, of which one-third are Chinese, one-third Indo-Chinese, and the remaining third Sawankhalok celadon, all appearing to be pre-Islamic in type and date, but mostly of the later phase.

The large collection of midden material, however, tells a different story. Only 40 per cent is Sawankhalok and pre-Islamic Chinese, and 30 per cent 15th and 16th century Chinese, while the remaining 30 per cent is of the Spanish period. This seems to indicate a continuous village inhabitation from the late 13th century down to modern times, with perhaps a brief interruption in the middle 15th century (the 1430–1450 switch to Islam). However, since the burial site is wholly pre-Islam, it seems likely that after the middle 15th century the dead were buried elsewhere, or without the usual grave furniture of ceramic wares, ornaments, weapons, and other objects.

Study of Sites 1 to 7 indicates that most of the pre-Islamic trade and commerce with foreign lands came to the north side of Jolo Island until Islam entered there and put a stop to it. On the other hand, the south side of the Island seems to have resisted Islam the longest, and to have gone on trading with Siam and Indo-China for a generation or two longer than the north side.

The hiatus in our sites always occurs between 1380 and 1450, and it seems that this 70-year period covers the time during which Islamic influence was slowly spreading over Sulu. During the first half of this period the hiatus is chiefly apparent on the north side of the Island; while during the last half (1420 to 1450 especially), it is chiefly apparent on the south side. It was during this period that what we call the "intermediate type" of Sawankhalok wares came in, and their presence or absence in a site is a remarkably accurate date index to the spread of Islamic influence. (Trade with Siam was apparently stopped as soon as Islam became dominant in a community; and it was not renewed again until the late Satchanalai period.)

Sulu Site 8.—A small site, known as "Bud Laba," where about a dozen whole or damaged ceramic pieces have been accidentally excavated while replanting a banana-grove destroyed by the 1932 hurricane. All of the pieces that I have seen are of the 13th or the 14th century and no post-Yuan wares are known to have been found there. (The site offers an interesting place for further exploration.)

Sulu Site 9.—This site, known as "Tubig Jaikah," is one of the most interesting yet found in Sulu, but has

been very little explored in proportion to its importance. The three lots of material that Captain Roth obtained from different parts of the site all seem to show different dates. The first and oldest lot, found while planting bananas along one side of the area, contains two whole Chinese jarlets of a very early type (probably not later than the 12th century). Captain Roth gathered a small quantity of midden material, partly from the deep holes where the banana-planting was done and partly from shallow cultivation near the surface. The older midden material from the holes is definitely pre-Islamic and with it were found 13 iron coins of the usual Sulu early 15th century type as well as some Indo-China fragments and other 14th century wares. Also some good native pottery of the decorated type. The surface material contained 15th and 16th century Chinese wares, and some Spanish-period fragments as well.

From the total material, it seems likely that three different communities existed in this area in the past—one early Sung, another covering the 14th and early 15th centuries, and a final Islamic-period community beginning in the late 15th or early 16th century and lasting well down through the Spanish period until relatively modern times.

Perhaps the most interesting objects found here are the old Sulu coins, and as this is the last site where any considerable number were found, they will be discussed briefly. After much careful study of the available material and its history, I prepared in 1938 a short paper on Sulu coinage. A few of the conclusions on the pre-Spanish material will be set down here:

The ancient coinage so far recovered from pre-Islamic graves is all of iron, and naturally mostly so badly rusted that the characters and designs are no longer distinguishable. The general appearance is almost the same as the typical Chinese "cash," with a square hole in the center. All of the specimens so far found have come from 15th century graves, and probably entirely from the first half of that century. They are known as *kusingbasi* by the Moros, who say that they are plowed up from time to time in their fields, and who believe that they were made and used by their remote ancestors. They are said to be found with greatest frequency in southeast Sulu and in the Kulay-Kulay area, although Roth found them only in Sites 1, 5, and 9. Even tradition makes them pre-Islam—from a time when the Sulus still ate pork and other now-prohibited foods—and for this reason they call them by a different name from the coinage of the Mohammedan period, which is known as *kusingpiris*. The later coins

are also plowed up in the fields, but they are smaller and are always of copper, bronze, or tin.

The evidence brought out in my paper indicates that the Sulu iron coinage dates from around 1420 A. D., and a little after—just subsequent to the return of the three Sulu rulers who visited the Court of China in 1417. Among the gifts which the three rulers (or high ambassadors) are said to have received at the Chinese Court were 2,000 strings of cash each—and it seems likely that after their return to Sulu they wanted something of the same sort themselves. As iron was the only metal of which they had any great quantity, iron coins, closely resembling the Chinese copper cash but bearing Indo-Malayan characters and designs, were cast in the local smithies. How long this local coinage lasted it is not possible to say with certainty, but it seems most likely that it died out with the introduction of Islam around 1430, or shortly thereafter. Relations with Malacca replaced those with China and Java, and a whole new political set-up came into being. (It is interesting to see how closely Chinese historical records fit in with our actual archaeological findings in Sulu, as well as in other parts of the Philippines.)

Sulu Sites 10 and 11.—Site 10 covers the former Constabulary grounds at Parang; while Site 11 covers the similar grounds at the Asturias barracks near Jolo. They are combined here for the reason that they both contain chiefly decorated native pottery of a special type, obtained from excavations made for building and drainage activities around the parade grounds. At Site 11 only one porcelain fragment was found, and this proved to be very early Ming; but at Site 10 a considerable quantity of porcelain and stoneware fragments were obtained—practically all of the 14th and beginning of the 15th century. The latter site ends with the appearance of the "intermediate type" of Sawankhalok wares; in other words, it comes to an end with the appearance of Islamic influence. A burial-site also existed at Site 10, and one good Sawankhalok green celadon deep dish of fine quality was excavated there as well as the broken fragments of an original whole "red-bottomed" dish of good quality. The decorated native pottery is of special interest, and has been discussed elsewhere.

Sulu Site 12.—This site includes a number of small areas in the Patikul District, to the northeast of Jolo town, in the northernmost bulge of the Island. From one area, known as the "Panding Site," in Lati barrio, two brown-glazed stoneware jars of early Ming types were obtained, as well as a still older unglazed jar that may be Yuan. Another area, known as "Takas Bunka

Ogaon," near Mt. Takas, a little to the south of Patikul town, produced a small but interesting lot of late pre-Islam midden material. The other Site 12 lots seem to be from small and unimportant areas.

Sulu Site 13.—This site, known as "Bud Tukay," covers an important area surrounding Mt. Tukay, a short distance to the northeast of Parang. The part of the site explored by Captain Roth seems to lie only on the south slope of the mountain towards the sea (although a considerable distance from it). Four whole or damaged ceramic pieces were sent to me from this site, while Hester had eight more, and Roth kept one good piece for himself. All 13 pieces are either Yuan or very early Ming, and have evidently come from pre-Islamic graves. They present no unique or special characteristics. (This area and other parts of Bud Tukay should be more carefully investigated.)

Sulu Site 14.—Midden material from Indanan town (partly collected by Roth and partly by myself during one brief visit); so far mostly Late Ming and early Spanish period fragments were found. (But later the nearby Langpas Site was located; see No. 16, below.)

Sulu Site 15.—This site, known as "Bud Makam," contains some interesting probable Indo-China and South China types among the grave-pieces, probably all of the 13th or the 14th century. The Hester Collection contains a good Chinese celadon dish (probably 13th century) from the same site. All pieces were accidentally excavated, and it is evident that the area should be systematically explored.

Sulu Site 16.—This important site is located on the farm of Abdurahman in the sitio of Langpas, Indanan district; and was first discovered on April 21, 1938. Accidentally plowing up some porcelain pieces, Abdurahman took them to the house of Samad Amat (Ahmad), a former municipal president who had been one of Captain Roth's assistants in his previous work. Ahmad instructed Abdurahman how to excavate the site, and took charge of all material obtained which was later shipped to Manila. Although much of the material is broken, it is interesting as coming from a single small site in one field, and all excavated at one time. It was accompanied by several sheets of detailed notes, in the picturesque English of Samad Amat, describing the place and the work done; which notes add considerable interest and value to the lot.

The field is near the house of Abdurahman in Langpas sitio, about 15 meters from the Jolo-Silangkan Road, and may be hereafter known as "Area B." The orig-

inal Langpas Site, which we may call "Area A," was one of the later discoveries of Mrs. Spencer, and had been excavated for her in 1933 by a number of Moros under the direction of the late Counsellor Sali, many whole and broken pieces being obtained at various times. Captain Roth had previously obtained about 20 of these pieces from Mrs. Spencer for the Hester Collection. The original Area "A" was first found by a woman named Hadida, who reported it to Mrs. Spencer in the early part of 1933. The known pieces from that area are all pre-Islam, and contain many Thanh-hoa and other Indo-China types. There is no doubt but that the two Langpas areas are close together, and the location of "B" is positive; but just where the Area A graves lay, in relation to B, has not been exactly recorded.

The following further data relate to Area B only: The collection contains no blue-and-white specimens at all, nor any Siamese wares of any type yet recognized, yet the entire Area B collection seems to date between 1250 and 1350, or wholly within the Yuan period. It is possible that a few earlier pieces may be included, but certainly none later than the date indicated. Only monochromes appear, and yet only one specimen approximates a definitely Chinese Sung glaze quality. A considerable number of monochrome hole-bottomed dishes appear, along with five whole Thanh-hoa types; and, among the Chinese wares, a great variety of the so-called "Lubug glassy glazes" so characteristic of Site F in Rizal Province. Also an interesting intermediate type of glaze that seems to be leading up to the beginning of the "glassy" type.

A few pieces of incised native pottery, and a large lot of a peculiar thin black-glazed stoneware, also appear among the Area B material. On the whole this site is more suggestive of the famous Kalumpang Site 22 of Rizal Province than of any other area known to me, and they seem to be both of about the same date.

Minor Sulu Sites.—A considerable number of single ceramic pieces, or small lots, in both Mrs. Spencer's and Roth's collecting, have come from other areas not listed above, but the data is insufficient or otherwise not worthy of record here. One rather remarkable thing about the Sulu sites is the almost complete lack of beads, jewelry, and ornamental objects in the graves so far excavated.

Ancient historical records and survivals.—Chinese writings of the 15th century and earlier indicate that the pre-Islamic Sulus were using an Indian syllabary of the usual Malaysian type; but no copy of it has survived, because of the early introduction of the Arabic alphabet. Ancient Sulu historical records have all

been transliterated into Arabic writing, and recently there has been a tendency to Romanize many of them. Many destroyed old records were re-written from memory by the royal scribes and others, following some of the wars mentioned at the beginning of this Jolo Island section. Particular attention should be paid in the future to a reconstruction of early Sulu history through use of contemporary records from Mindanao, Borneo, Celebes, Java, Malacca, and other islands, as well as the use of Indian, Arabic, and Chinese accounts. Two famous early travelers who appear to have visited Sulu territory in the 14th century were Friar Odoric and Ibn Batuta. The accounts of these travelers should be carefully studied.

Important monumental remains also exist in Sulu and elsewhere that throw light on Sulu pre-Spanish history. A Sulu king (or "Batara") died in China in 1417, and in 1912 his tomb still stood a short distance outside the Anteh gate at Techow, in the Shantung Peninsula. In 1408 a famous Chinese captain—now known by the ritualistic or sacred name of "Pun-Tau Kong"—died in Sulu, and was buried in the royal teak grove a short distance outside Jolo town. He has become the Patron Saint of the Sulu Chinese, who have reconstructed his tomb and included portions of the orginal stones and inscriptions that remained there. The most famous monument, however, is the tomb of Raja Baginda, which still exists on Bud Datu, back of Jolo town. The original tomb was on the truncated top of a large artificial pyramidal mound, now partly broken down. Alexander Dalrymple reconstructed it in the middle of the 18th century, and placed a new inscribed stone there which still exists. The original stone (dating between 1380 and 1420) was still at the foot of the grave when I first visited it in 1919. (I have good photographs, both of this monument and of that of Pun Tau Kong.)

Other important tombs of early Sulu rulers still exist in the vicinity of Bwansa (fig. 2), and some of them also have inscribed stones set up by Alexander Dalrymple in the 18th century. Also, in 1873 Sir Hugh Low was still able to find two stones from the tomb of Lela Men Chanei, daughter of the Batara of Sulu who became the wife of the famous Nakoda Ragam (fifth Mohammedan Sultan of Brunei, whose reign began about 1500 A.D.), beside her husband's tomb on the hill back of the ancient town. He further states: "I saw two other stones which had formed part of this lady's tomb, in the burial ground at the *Kiangi* above the *Upas*, under a large *waringin* tree." (At Brunei.)

At Parang and elsewhere old graveyards exist which are filled with ancient wooden monuments and markers, but none of these are likely to be pre-Spanish. However, on Sibutu Island and elsewhere such monuments exist in stone, and some of them may be much older. (See No. 67, below.)

Sulu still contains a mine of ancient things, available to the archaeologist, and much further and more systematic work is indicated there.

Workers.—(As indicated under the preceding various items.) Also Francisco Combes, Thomas Forrest, J. H. Hunt, Charles Wilkes, F. H. H. Guillemard, Vicente Barrantes, Miguel A. Espina, T. H. Haynes, Charlie Schuck, Adolph Gunther, N. M. Saleeby, David P. Barrows, Hadji Butu, Sheik Mustafa, Howard R. Hickok, K. W. Walker, W. O. Johnston, Charles E. Livingston, H. Bruce Stephenson, Charles R. Cameron, James R. Fugate, Francis L. Link, Carl M. Moore, Paul D. Rodgers, Sixto Y. Orosa, H. O. Beyer, Princess Tarhata Kiram, Julpa Schuck, Guy Stratton, John W. Ziegler, Hadji Usman, Omar and Hassan Bagis, Arolas Tulawie, Datu Ombra Amilbangsa, and others.

67. *Sulu Province (including all other islands except the Jolo group and Cagayan Sulu)*: *(Especially the Siassi, Tawitawi, and Sibutu groups)*:

(No Stone-Age nor any other specific pre-Porcelain-Age remains have been reported; but it seems probable that future systematic work may turn up at least remains of the Neolithic and after. No systematic work has been done on any island except Jolo itself, and all the numerous finds in the southern islands have been accidental or casual, except Powell's brief exploration around Dungun on Tawitawi and a brief survey of the Sibutu west coast by Crosby and myself. Many of the southern islands are potentially very interesting, however, and some of them are known to have been inhabited from very remote times. Extensive exploration work should be carried out there at the earliest opportunity.)

Porcelain-Age finds and survivals.—Doctor Guthe explored no sites in the southern Sulu islands, except one on the east end of Tawitawi. He gives no results. The earliest collection from the Siassi group went to Mrs. Spencer's Collection, which contained a considerable number of good specimens from Siassi, Lapak, and other places. However, none of the specific sites were recorded, and they doubtless all came from accidental finds. The Hester Collection contained a number of good pieces from South Ubian, Sibutu, and other islands. Only one item of this collection has an exact site-record—a Late Ming brown-glazed jar, with five lion-head ears, which was excavated on the southern slope of the small hill near the northern end of Sibutu Island. Mr. Hester obtained the specimen from the same Moro who excavated it in May, 1933. A number of other specimens have been accidentally excavated on Sibutu, several of which were taken by Willie Schuck to his home in Bongao, and a few others are in my General Philippine Collection.

The Sibutu grave-stones.—The most interesting remains on Sibutu Island, however, are the stone monuments and tombs which line a considerable part of the west coast. They were

examined, and many of them photographed, by myself in company with William Crosby, first in 1921 and more extensively in 1923. These are the best examples of stone tombs and ancient grave-monuments that I know of anywhere in the Philippines; and some of them are very elaborately carved. The designs are more or less similar to those of the wooden markers found on other islands, although some of the scroll-work is more elaborately worked out on the stone. They undoubtedly cover several centuries of time, but just how far back the earlier ones go is uncertain (my own estimate would be the 15th century). Most of them are made of a white coralline limestone (the older ones grey with lichens), but a few seem to be made of other harder stones not found on this Island. All of the remaining specimens, numbering several hundreds at least, should be photographed and studied in the near future. Some of those which are buried in the forest have already been much damaged by trees and large roots.

Many of the carved wooden head-stones, markers and monuments on other islands—mostly made by Badjaos and Samals at various times in the past—are worthy of study and permanent record. The best that I have seen are on Sitangkaï, Simonol, South Ubian, North Ubian, and at Parang on Jolo Island; and the great number of types and varieties in artistic workmanship is remarkable.

The island of Simonol also contains the remains of what is saïd to be the first Mohammedan mosque built in the Philippines (14th or early 15th century); and the vicinity of this ruin should also contain other interesting midden remains.

The Tawitawi area.—My General Philippine Collection contains two interesting specimen-lots (partly destroyed during the war) from Tawitawi Island and particularly from the ancient capitol-site of the Sulu Sultanate at Dun͠gun—one lot collected by the late Governor Carl M. Moore, and the other by Ifor B. Powell.

The prize specimen of Governor Moore's lot was a heavy stoneware jar excavated in 1926 by Datu Maulana from a grave near the ancient Dun͠gun site. This grave, by Moro tradition and records, was calculated to be 563 years old at that time. However, upon examining the jar itself it was found to be a South China production from the well-known Shekwan factories; and, while R. L. Hobson believes that the Shekwan kilns go back to Sung times, my own experience with this ware is that it did not enter the Philippines (in the form of jars, at least) before Late Ming times, and most commonly in the 18th century. Therefore, the most that can be said of this Dun͠gun jar is that it is probably of the 17th or 18th century, and not of the late 14th century, as the Datu Maulana and his Moro friends believed.

The old Duñgun site is very interesting, however, and parts of it doubtless go back well into pre-Spanish times. But the period of Duñgun's greatness was the late 17th and first half of the 18th century, and it is from that period that the specimens in Powell's collection date. Two features of the Powell material are exceptionally interesting: First, the decorated native pottery, which has some unusual and elaborate incised and stamped designs; and, second, the presence of some interesting pieces of large *dinulang*-type dishes of the 17th and 18th century, made in the old Singapore kilns which were discovered by H. D. Collings and myself in February, 1938. (Powell's specimens were collected at Duñgun in April or May, 1928—and we did not then know the source of the *dinulang*-type material.) One piece, found in the bank of a ravine, may even be of the middle 16th century, from the color of the blue design and texture of the ware.

All that is now left of ancient Duñgun (completely abandoned about 1760) is the levelled hill-top or elevation on which the palaces stood, and the remains of a great stone stairway leading up to it. The buildings were apparently all of wood, as no visible walls or stone structures exist; and Powell's specimens were mostly found on the south and west slopes of the truncated hill. The broken remains of three jars found in a ravine are certainly Ming, and may also be of the 16th century.

Pre-Spanish survivals.—Some fine examples of old Sulu gold jewelry, ivory and gold *barong* handles, and of silver, bronze, and copper *buyo* boxes, formerly existed in my General Philippine Collection; but they were all looted or carried away by Japanese soldiers during the early 1942 phase of the war. Many of the better pieces were several centuries old, and all were of pre-Spanish styles.

Some of the native Sulu pottery is still of pre-Spanish types, both as to form and decoration. Especially good examples are to be seen on Tawitawi Island and at Parang on Jolo Island. The pottery stoves of Tawitawi are of an early form, derived from Chinese prototypes coming between the 12th and 14th centuries.

Many other elements of Sulu art, especially in the way of wood and ivory carving, textile patterns and embroideries, and metal work, go back to pre-Spanish and sometimes even pre-Islamic prototypes. Also many features of social life and culture, music, dancing, and dramatic art, all reminiscent of Java and Sumatra, have probably survived since the days of Sri-Vishaya and Madjapahit, although some Malaccan, Siamese, and Chinese influence is also in evidence.

Workers.—(As indicated under the preceding various items.) Also Thomas Forest, Alexander Dalrymple, Capt. Mundy, N. M. Saleeby, Sydney Cloman, H. Bruce Stephenson, Francis L. Link, Edward H. Taylor, Albert W. Herre, Paul D. Rodgers, Percy Machlin, Carl N. Taylor, Aleko E. Lilius, John W. Ziegler, James R. Fugate, F. G. Roth, Hugh L. Scott, Eduard M. Kuder, and others.

68. *Borneo Island (especially British North Borneo, Brunei, Sarawak, and parts of Dutch Borneo)*:

(Being one of the world's largest islands, nearly three times the size of the total land area in the Philippines, and located in the very center of Malaysia, Borneo, ancient home of man, obviously should contain rich and interesting archaeological remains. This Island being bisected by the equator, perhaps its climate together with the generally backward state of political and economic development have been largely responsible for the small amount of exploratory work that has been done. Due to the great size of the area, no adequate account can be given here even of the little that has been accomplished in the way of archaeological studies; but a general outline of the outstanding finds affecting Philippine study will be set down. Many scattered finds of the last two or three decades have not come to my notice, and only a small part of the rich literature in Dutch has been consulted.)

Tektites.—True tektites have been found in small number in three widely separated regions in Borneo, one in the north and two in the south. The oldest known Far Eastern tektite specimen was found in 1836 in a gold placer at Pleihari, in southeastern Borneo; and other specimens were found in the same region in 1897 while the finder was washing diamond-bearing soils. Also to the south of Martapura, in southern Borneo, several scores of tektites have been found in placer workings—of which I formerly had eight specimens in Manila (all but two lost during the war). In northern Borneo, four good tektites were found in February, 1913, by Dr. F. P. Mueller, in a middle Pleistocene sand-bank, or terrace, on the northern edge of the village of Tutong Station, southwest of Brunei town.

The only finds reported during the last 30 years have come from Martapura. The natives value them highly as charm-stones, and the Sultan of Martapura wears one, mounted in an ornamental silver setting, as an amulet.

Palaeolithic remains.—In 1878–1879 A. Hart Everett explored some 20 caves in Sarawak; but found no evidences of palaeolithic occupation. However, he did find one famous palaeolithic cleaver, or *coup de poing* (now in the Oxford Museum), which was the subject of much discussion in scientific journals of Great Britain and the Continent, the general conclusion seeming to be that it was the first genuine Palaeolith discovered anywhere east of India. The specimen as found by Everett was lying near the bottom of a gravel stratum exposed in cross-section in the left bank of the Siniawan River, and had to be pryed loose from its firmly imbedded position.

Ling Roth in 1896 illustrated another possible palaeolith or mesolith, labelled as being found in Borneo, in the hands of a London dealer; but no site-locality or other data could be ascertained.

In connection with his 1913 discussion of Neolithic remains in North Borneo, I. H. N. Evans illustrated a core and 14

chert flakes, concerning which he says: "These flakes are extremely abundant in the lower portions of the Tempassuk district, and can be found in numbers on the smaller foothills." This statement, together with the small size of the flakes, seems to tie them up pretty definitely with Mesolithic and Early Neolithic microliths and semimicroliths so common in south-central Luzon, and also found in Panay, Mindanao, Celebes, and other islands.

Neolithic finds and survivals.—Ling Roth, in 1896, found no records of Borneo neoliths; but in 1913 Ivor H. N. Evans published illustrations[4] of 17 polished specimens collected by him in the Tempassuk district of British North Borneo (of which three are possibly Early Neolithic and the remaining fourteen Middle and Late Neolithic). Dr. A. C. Haddon found one adze in Sarawak, and Dr. Charles Hose collected 15 specimens of polished adzes and chisels (also from Sarawak) and presented them to the Cambridge Museum of Ethnography. In North Borneo they are called *gigi guntor* ("thunder teeth") and are highly valued as charms. Three of Evans specimens, and one other that he saw but could not obtain, were of nephrite; while four others were of black hornrock or fine-grained basalt—all similar to the plain-backed Batangas specimens. No true "stepped" or "shouldered" celts occur in any of these collections. One gouge and two or three groovers were found. From Dutch Borneo, Heine-Geldern illustrates a polished Early Neolithic axe of true "walzenbeil" type; but, on the whole, this type is very rare in Borneo finds.

Bronze-Age remains.—Since bronze celts of several typical forms have been found in the Philippines, Celebes and Moluccas, Java, and Indo-China and South China, they should certainly occur in Borneo, but I have not yet come across any record of an actual find there. According to Heine-Geldern, fragments of early bronze drums of the Dongson type have actually been found—probably in Dutch Borneo—but the details are not given. A number of bronze images have been found in the Badjarmasin area, but they all doubtless date from the Iron or early Porcelain Ages.

Early Iron-Age finds.—Two important areas containing actual Early Iron-Age remains have been explored on the west coast of Borneo, one in southern Sarawak, quite thoroughly explored in 1908 by Harold H. Everett and John Hewitt and later re-studied by Dr. Joseph L. Shellshear in 1925, and the other, in Dutch Borneo, casually explored by a geologist in 1923.

The Santubong Island Sites.—This island lies in the delta of the Sarawak River, not far from Kuching. The first important collection known to have been made on the island was by Sir James Brooke, and was lost when the Rajah's palace was sacked by the Chinese in 1857. A good many other important specimens were found on the island at various times and

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[4] Man, 86.

carried away by both natives and Chinese. The first systematic exploration was attempted by Everett and Hewitt in 1908, but they by no means exhausted the possibilities of the area.

The main area of exploration was a strip some 50 yards wide, extending for about 1½ miles along the shore of the river, ending at the small Santubong River on the west, and being easily distinguished by the presence of quantities of characteristic black slag. The following articles have been found within this area, which appears to have been both an ancient townsite and burial-ground: Gold ornaments, beads of many kinds, bracelets, quantities of potsherds, iron slag, some Chinese coins, one small Hindu image of baked clay, and several carved stones.

The gold ornaments found were mostly beads of fine workmanship, but some resembled the nose-ornaments worn by Indian women while others were probably ear-pendants. (Similar gold ornaments have been found at other places on the Sarawak River, particularly on the left-hand branch below Penkalanampat, and at Bidi. Also in the north, not far from Tanjong Sipang.) Very few silver ornaments were found, chiefly beads and bangles.

The beads were of many varieties, chiefly of glass and glassy pastes, but a fair number of stone beads also occurred—mainly carnelian, agate, jasper, and rock-crystal. Both round and angular forms were found among the stone beads, and they were obviously of local make as unbored and half-bored specimens were found, and some merely roughly blocked out and not yet polished. A type of bead made from iron slag was also in evidence (as at Novaliches in the Philippines, and at Kuala Selinsing in the Malay Peninsula). Yellow, red, and blue were the commonest colors among the glass beads; and there was evidence that some of these might have been made locally, although others were doubtless imported. Some bead-tubes were found with the individual beads not yet broken apart. The quantity both of good beads and wasters was so great that Everett, Hewitt, and Shellshear all believed Santubong to have been an important ancient center of the bead-making industry. Only a few beads of the striped and spotted types now regarded as of Greek or Roman origin were found.

Fragments of blue-glass bracelets were found, but no whole ones. (Similar types have been found in the caves of Upper Sarawak, and at Sibu, as well as in the Baram district.)

The potsherds found were chiefly of red earthenware, and such Chinese wares as occurred were mostly of crackled celadon. The native pottery was mostly covered with incised or impressed designs. Only a few whole pieces were found, most of them being already broken. Many pieces of crucibles were found, a few of them containing remains of iron slag.

Of several curiously carved stones, a life-size human figure sprawled on a large rock, face downward, is one of the most remarkable. Another is a crudely carved monument, on a

hill 300 feet above the water-level, with curious geometric figures carved on two sides. No sort of written characters or inscriptions were found. The small Hindu clay image is of a female figure, but cannot be dated.

Chinese coins were quite numerous in different parts of the site, and seem to indicate two villages located there at quite different times in the past. One contains only coins running from the 6th to the 11th centuries; while the other is quite modern, running from the 17th to the early 19th centuries only.

Shellshear's later studies make it plain that the older and principal section of the Santubong site is Middle and Late Iron Age, with an Early Porcelain-Age site of the Tang period coming in about the 8th or 9th century. Later inhabitation was in the nature of small villages, covering only portions of the area. The specimen-bearing deposits in the main site are about four feet in depth, and below this the soil is usually barren.

The Papan Island Site.—Some time prior to 1922 Professor Vermaes, of Delft, brought to Prof. R. W. van der Veen for study and analysis some remarkable lumps of blue and green artificial glass that had been found in large number on the small island called Papan, off the west coast of Dutch Borneo. The analysis and characteristics of this glass show clearly that it is identical with that of the Early Iron-Age bracelets and beads (the blue and green varieties only) found so numerously in our Rizal-Bulakan sites, and also at Santubong in Sarawak and Kuala Selinsing in the Malay Peninsula. As these "glass stones," as the people call them, are washed up on the beach by the waves, it seems likely that an ancient Iron-Age village was long ago washed away here by the sea, but that the site was near enough to the present shore line so that artifacts from the village are still occasionally washed up. The finding of this site supports our previous view, developed in all of the other three areas, that the blue and green Iron-Age glass was usually of local manufacture. (The larger lumps of this Papan Island glass are from 2 to 3 inches in diameter.)

Porcelain-Age and burial-cave remains.—A large number of burial-caves have been explored, with various degrees of proficiency, in many parts of Borneo. In addition to the 20 explored by A. Hart Everett in 1878-1879, Shellshear and others explored Sarawak caves, C. V. Creagh, I. H. N. Evans, and Harry G. Keith those of British North Borneo, and various explorers, an unknown number in Dutch Borneo. The results of some of these explorations went into the Sarawak Museum at Kuching, or into the small but good North Borneo Museum at Sandakan. It is to be feared that most of the specimens either were destroyed or they disappeared during the war. Some collections from both areas may have been preserved in the Raffles Museum at Singapore, which escaped serious damage.

Everett's early explorations were not very scientifically conducted, and he seems to have removed only a small part of the material found. His notes indicate great similarity with the Visayan Islands and western Mindanao burial-caves. Wooden coffins, broken burial-jars, and quantities of ceramic fragments, rusted iron weapons and tools, and disintegrated skeletal material are the general characteristics, but there is considerable difference in detail, and as between some localities and others.

The Batu Puteh Caves.—In March, 1895, C. V. Creagh explored a group of caves located in a large limestone hill on the left bank of the Kinabatangan River near the Batu Puteh Estate, in British North Borneo. Several of the caves at lower levels contained quantities of burial-remains in a disturbed and broken condition; but one large cave, high up on a cliffside (between 70 and 80 feet from the ground) was found undisturbed. This upper cave contained 40 ironwood coffins, mostly elaborately carved, each with an undisturbed skeleton inside together with personal jewelry, whole or broken pieces of Chinese and native ceramic wares, weapons, and other objects. Coffins of men, women, and children were found, of various sizes and types of decoration. The men's coffins seemed most frequently decorated with protruding heads of carabaos, cattle, and the like while those of women and children were usually decorated with figures of lizards, crocodiles, and snakes. One man's coffin (with contents intact), elaborately carved with geometric designs and two carabao heads at the ends, was removed to the Sandakan Museum; while the remaining contents of the cave were placed under official protection and preserved in place.

The Bau Caves in Sarawak.—These were first visited by O. Beccari prior to 1868, and he mentions especially the skeletal remains that he found there. Later, some of the contents were removed to the Sarawak Museum at Kuching; and in 1925 Shellshear saw there an interesting gold ornament from a Bau cave, about two inches in length designed in a spiral motif, with two spirals on each side, that seems to be descended from a Bronze-Age prototype. Beccari also speaks of some gold ornaments of various designs found at Pengkalan Ampat, together with a large Persian coin dating from 960 A. D.

Shellshear examined numerous caves in the vicinity of Bau, in 1925, and especially the *Lobang Angin* (or "Cave of the Winds") in which ancient burials were found. Beside one partially preserved skeleton, that seemed to be that of a middle-aged man, a beautiful bronze axe, a bronze bracelet, and several species of shells (including cowries) were found. Shellshear disturbed nothing else at that time, feeling that the site was worthy of systematic study and excavation by a competent archaeologist.

Evans' notes on North Borneo.—About 1912-1913, Ivor H. N. Evans spent some time in the Tuaran and Tempassuk dis-

tricts of North Borneo, and, in addition to his stone implement findings, made several other observations. He states that fragments of old celadon-ware, jar-fragments, and other objects, can be picked up frequently around the bases of the foothills—but he seems to have explored only one such site. He also mentions an interesting ancient gold ornament found accidentally in a rice field.

The one old village-site explored lies on the hill called Tudu, overlooking Usakan Bay, in the Tempassuk district. There seems to have been at one time an ancient fortified village there. Some small excavations were made by Evans, in the way of intersecting trenches about 2½ feet deep. Many fragments of native pottery, animal bones, sea-shells, and other objects, were encountered, and two fragments of Chinese celadon-ware. Two stone implements were also found, one of which appears to have been a polishing stone and the other a grip-marked hammer. By Philippine analogies, the site would seem to be a mixed Late Iron and Early Porcelain-Age culture. Evans had only one day available for the work, and felt that much more could have been found had he remained there longer. (If the site is still undisturbed, it should be excavated and studied systematically, as Evans probably missed the richer part of the area.)

H. G. Keith's Collection.—For several decades past Harry G. Keith has been connected with the Forest Service and in charge of the Sandakan Museum in British North Borneo. During the decade just prior to the war he accumulated a small but good personal collection of about 200 pieces of early ceramic wares (all prior to Middle Ming), mostly found in North Borneo. His own estimate in February, 1940, was that he possessed two Tang pieces; a large number of Chinese Sung, Yuan, and Early Ming celadons; a considerable number of Sawankhalok pieces, both celadon and otherwise; and a few good Early and Middle Ming blue-and-whites. I have no notes concerning specific sites—and his own notes, as well as the collection, were probably a total loss during the war.

Further notes on Neolithic adzes.—Since writing the first part of this section, I have come across the following additional notes in Hose & McDougall's "Pagan Tribes of Borneo" (Vol. II, p. 11, footnote): A. C. Haddon first discovered an adze specimen in a Klemantan house in the Baram basin, in 1899, but Schwaner had many years earlier reported seeing such stones in native houses in Dutch Borneo. In many Kenyah houses, among the charms hung beside the heads, in the galleries or over the fireplaces, one or two stone axe-heads may be found. They regard them as teeth dropped from the jaw of the thunder-god *Balingo,* and it is usually claimed that some ancestor found these stones and added them to the family treasure. They are frequently carried when going to war. The famous Malang chief, Tama Kajan Odoh, who claims descent from Balingo, is

said to possess the unusual number of ten such teeth. They usually will not be sold for any reasonable price.

Historical, heirloom, and literary antiquities.—Many remains of Hindu times have been found throughout the Island, but particularly in Dutch Borneo. The oldest and most famous are the Kutei inscribed monuments, first reported by K. F. Holle in 1879, and presented to the Batavia Museum by the Sultan of Kutei in 1880. There are four inscribed stones in all, originally found at Muara Kaman, some distance up the Kutei River. They were first studied, from handwritten copies of the inscriptions, by Prof. H. Kern, who assigned them a date of 400 A. D. and published several papers concerning them in 1880-1882. They were re-studied in greater detail, in 1917-1918, by Dr. J. P. Vogel who published accurate copies of the inscriptions from well-made rubbings. He agrees with Kern that the monuments were erected by King Mulavarman in 400 A. D., but has made important corrections in translating and interpreting the text. One of the inscriptions gives the names of Mulavarman's father and grandfather (carrying Kutei history back to about 300 A. D.); and shows that the latter had a native name while his son was the first to adopt a Hindu name of Pallava derivation. The time of Hindu entry into this area is thus indicated to be the 4th century, A. D.

A list of several scores of isolated finds of monuments, images, coins, and other datable antiquities of the Hindu period in Borneo, has been published in Java—but I do not now have access to it. Sir Spencer St. John, H. Ling Roth, and others, mention several Hindu monuments, images, etc., as being found in Sarawak—including part of a stone bull that once stood near the bank of the Sarawak River and was later removed to a special shelter near Sir James Brooke's first residence. St. John speaks of gold images of Hindu type being found in land-burials, with other gold ornaments, pottery, and porcelain. "sometimes as much as seven feet deep."

Chinese records contain much data on the early history of Borneo, and several times mention their ancient writing, "which was like that of India." The old Bornean syllabaries have been lost, like those of Sulu and Mindanao, chiefly owing to the general introduction of Arabic writing in the 15th century. Some transcriptions of older records were doubtless then made; but good Mohammedans tended to frown on all that was pre-Islam. Sir Hugh Low has preserved for us some of the best records going back to the beginning of the Islamic period. He has also described some of the ancient monuments and tombstones of the early sultans and their wives, that still existed in his day in the environs of Brunei.

The Panay *Maragtas* has important data on North Bornean history in the 13th century; while the *Pararaton* and

Nagarakretagama of Java say much of Borneo (Tandjongpura) in the time of Madjapahit. Even the early Arab voyagers have accounts of Borneo, although difficult to interpret.

Ling Roth has much to say of ancient writing in Borneo, including inscriptions on the bottom of an old jar and on a dagger-blade, but conclusions are in all cases doubtful. However, it seems quite possible that future archaeological work may turn up inscribed stones or copper plates that may considerably clarify our present knowledge, as they have done so effectively in India, Java, and Indo-China.

Workers.—(As indicated under the preceding various items.) Also Chau Ju-Kua, E. S. Lane, Antonio Pigafetta, Thomas Forrest, Alexander Dalrymple, E. Belcher, Carl Bock, Rajah Charles Brooke, G. W. Earl, W. P. Groenveldt, J. Hunt, H. Keppel, Capt. Rodney Mundy, A. W. Niewenhuis, W. H. Treacher, N. Utsurikawa, Alfred Russel Wallace, J. Whitehead; Pedro A. Monteclaro, Donald A. Owen, James A. Robertson; E. Banks, Major Moulton, W. H. Smith, Owen Rutter, Agnes N. Keith, Dr. Tadao Kano, Martin and Osa Johnson, and others. (See also Addendum for further Borneo data.)

69. *Sangir and Talaut Islands (between Mindanao and Celebes):*

(Known as "the Sacred Islands" to the people of central Malaysia, these two small groups form both a physical and biological connecting link between the Philippines and the Celebes-Moluccas area. Having been very anciently inhabited, they were an important Madjapahit colony, and were found with a quite numerous population when the Portuguese, Spaniards, and Dutch first entered the area. The Sangir people were largely Christianized between 1563 and 1568 by a Portuguese Jesuit named Fr. Diego Magallanes, and remained Catholic under the Portuguese and Spaniards until after the Dutch took over the region in the middle 17th century. Gradually, under Dutch influence, they shifted to the Protestant Reformed Church, which still maintains its influence there. However, Islamic influence from the Moluccas and from Mindanao has been strong, and many elements of the old paganism also survive.

Archaeologically, little or no work has been done in either group, although the opportunities for systematic work are excellent. The oldest known remains are some Neolithic axes or adzes said to be preserved as potent charms by the medicinemen. Bronze- and Iron-Age survivals indicate that these cultures were probably also once current, but no actual sites or excavated specimens have been recorded. Porcelain-Age ceramic specimens have been occasionally collected there, in several of the islands; but there is no record of any specific sites or excavations. Hickson speaks of seeing the tomb of an ancient chief, about 1888, which he describes as follows: "It was a massive structure, composed of a concrete rubble of sand and burnt corals; at one end of it was a rudely carved crocodile, and at the other a model of an old-fashioned European sailing ship."

(The first known European account of these islands is by Antonio Pigafetta, when the remnant of the Magellan fleet called there after leaving the Philippines and Borneo in 1521.)

Workers.—Antonio Pigafetta, F. H. Guillemard, Sidney J. Hickson; J. Crawford, P. A. Tiele, Alfred Russel Wallace, G. A. Wilken, Mrs. Violet Clifton, and others.

70. *Celebes and the Moluccas Islands:*

(No tektites or early Palaeolithic remains have yet been located; all subsequent periods, however, are well represented.)

Late Palaeolithic and Mesolithic remains. The first attempt at systematic work in Celebes was carried out by Paul and Fritz Sarasin in the early years of the present century, and published in 1905. This consisted of an exploration of the so-called "Toala caves" around Lamontjong, and resulted in the discovery of a very interesting microlithic culture of typical Mesolithic character—although Heine-Geldern regards it as Late Palaeolithic. This was the first microlithic culture to be scientifically demonstrated in the Far East, except the classic ones of India. The second was my extensive Rizal-Bulakan microlith area in Luzon, study of which by Stein-Callenfels in 1928 led to his initiating search for similar remains in Sumatra and Java, and to a later resumption of the Celebes research. The latter resulted in new excavation by Stein-Callenfels, van Heekeren, and Willems, in the 1930s, in various parts of southwest Celebes. The work resulted in more Mesolithic "Toalian" finds, together with a new "Proto-Toalian" culture that seems to be truly Late Palaeolithic. The results were partially published in 1937-1938, but were never completely written up in detail. (The set of specimen types from these finds, contributed by Stein-Callenfels in 1937 to our comparative collection in Manila, fortunately survived the war.)

Neolithic finds, excavations and survivals.—As early as 1705 G. E. Rumphius published an illustrated account of the neolithic and bronze implements of Celebes, the Moluccas, and neighboring islands; and nothing better appeared until a similar and more extended review by C. M. Pleyte in 1887. In 1889 Sidney J. Hickson described the *watu ing kilat* ("lightning stones") of the people of the Minahassa Peninsula in Celebes, and demonstrated that they were Neolithic axes and adzes. Concerning them he says: "In some districts they are wrapped up in dry leaves and placed in a pot of water to cause rain, but by the Tombulus and Mongondus they are used as preventatives against lightning." In 1902-1903 A. B. Meyer and O. Richter published an 11-page paper on the "Stone-Age in Celebes," and added new examples. From North Celebes definite Early Neolithic round or oval axes have been demonstrated; and in 1932 Heine-Geldern published an illustration of a true "stepped" form from that area. (Only a few stepped specimens have been found in the Minahassa and the Moluccas, and they have doubtless gone down from Mindanao.)

The only important actual excavation of a neolithic site in Celebes appears to be Stein-Callenfels work at Galumpang—from which we have both his notes and a good set of type specimens in Manila. My judgment of this site, after a careful examination both of his notes and of the specimens, is briefly as follows:

The Sikendeng and Galumpang Sites.—Doctor Cense about 1933 excavated a site at Sikendeng and turned up a good number of polished Late Neolithic adzes, etc. Some natives, seeing Dr. A. A. Cense doing this work, reported that a few years previously, during the construction of a road near Galumpang, quite a lot of stone implements and potsherds had been found. A few months later Governor Caron and Doctor Cense visited the place, and within a short time were able to bring together a considerable collection both of stone implements of various types and of decorated potsherds. Part of the stone implements were of the same polished types found at Sikendeng, but others were of a very different and more primitive type; while the decorated pottery was ornate and highly interesting. Governor Caron accordingly wired Stein-Callenfels and asked if he would come over and excavate the site at the expense of the Celebes Government.

The Galumpang Site is three days' journey by dugout, upstream from Sampaga. The site itself is called Kamassi, lying a short distance to the southwest of Galumpang village, on the last spur of a range of hills jutting out into the plain at this point. The new road runs across the site, and an area of 100 square meters was excavated on each side of the road. It was soon found that the site had been used for agricultural purposes for a generation or two, and that the original stratification of the contents had been thoroughly destroyed. Artifacts of at least three and possibly four different cultures had been stirred up and mixed together. The separation of cultures was therefore wholly on typological grounds. The following culture-layers were decided upon after careful study of the material: (1) The earliest type appears to have been a mixed Hoabinhian and Sumatra-type Late Palaeolithic or Mesolithic culture. (2) The second oldest and most important layer consists of a mixture of finished and partly finished implements, all made of slate and strongly resembling the Formosan type of shouldered axe, as well as one or two similar specimens found in the Philippines. (This type is not found anywhere in southern Malaysia, and must have come down to Celebes from the north in the Middle Neolithic period.) (3) The third layer consists of Late Neolithic polished adzes and chisels of the usual plain-backed types. Some of the polished stone arrowheads and spearheads are probably also to be associated with this culture, but most of the others are of slate and are undoubtedly from the second culture layer. (4) The final decorated pottery bearing layer exactly corresponds to the Early Iron-Age pottery of Rizal Province in Luzon,

dating from the 2nd century B. C. to about the 1st or 2nd century A. D.

These are my own conclusions and not those of Stein-Callenfels, who is inclined to date the decorated pottery as Late Neolithic. He does not mention finding any trace of iron tools, but in the type of site he had to deal with they may have easily disintegrated into small rust flakes that might easily be overlooked or disregarded. As regards the shouldered slate axes, Stein-Callenfels states that similar specimens had previously turned up in both Central and North Celebes, and he agrees with me that they came down from the north and have nothing in common with the other central and southern Malaysian cultures.

He later excavated further at Doctor Cense's Sikendang site, and found more polished Late Neolithic implements; also a pottery-bearing layer which he regarded as contemporary, but which contained much plainer and less highly decorated ware than the Galumpang site.

Bronze-Age finds and survivals.—As already indicated, bronze celts from Celebes and the Moluccas were described and illustrated by G. E. Rumphius as early as 1705. Others were subsequently found, and reached domicile in the Batavia and European museums, but it was not until 1902 that they were again made the subject of a serious scientific study. In the latter year Meyer and Richter published another important 10-page paper entitled "The Bronze Age in Celebes," in which all known finds were reviewed. In 1923 Heine-Geldern correlated the Bronze-Age remains of Southeast Asia and Malaysia, including the Celebes and Moluccan finds, and discussed other remains besides celts, including bronze fish-hooks, other tools, and ornaments. The Philippine finds had not then yet been made, but he illustrates two celts from Celebes and Java that are very similar to those later found in Batangas Province. After the middle 1930s it also came to be known that the large decorated bronze drums of Malaysia (including an exceptionally fine specimen from a small island just south of Celebes) dated from the Bronze Age, and are to be associated with the Dongson culture.

Some huge stone vats and urns, on a plateau in central Celebes, have also been thought to be possibly Bronze Age in date, and to be associated with the stone-urn culture described by Dr. M. Colani from Indo-China. As yet, however, there is no certain dating for these remains.

Iron-Age and Urn-Burial remains.—That the decorated pottery of Galumpang is most probably Early Iron Age (Bronze Age at the earliest) has already been indicated. Certain beads, and specimens and fragments of Early Iron-Age blue and green glass bracelets, have also been reported by van der Hoop and others from the Moluccas and western New Guinea.

True jar-burials—of the same types as those found in Sorsogon, southern Tayabas, and Samar—were excavated in 1937 by W. J. A. Willems at Sa'bang, Central Celebes. Most of the skeletal material had entirely disintegrated. Like other special phases of Celebes culture already noted, there is little doubt but that the urn-burial type came down from the north. (I have shown elsewhere that the most probable motherland of the jar-burial culture is east-central China, and Fukien Province in particular.)

Porcelain finds and survivals.—Prior to the war I had some interesting photographs of extra-large Middle Ming blue-and-white dishes, found in use in sacred ceremonies in western New Guinea and some of the Moluccas Islands by Mr. and Mrs. R. G. Wind, in 1939-1940. Some of them are temporarily buried in pits, and later removed for re-use in other ceremonies.

During the war Commander K. Muto, of the Japanese Navy, who had been stationed in the Makassar and Boni districts of Celebes as an administrative officer, spent some weeks in Manila on his way to Japan in 1943. He had with him more than fifty small ceramic pieces, chiefly of the 14th and 15th century, all of which had been excavated in southern Celebes, which he brought to me for study and identification. I made sketches of a number of them, but due to our poor photographic facilities at that time, I was unable to secure proper photographs. About 80 per cent of the pieces were of types already known from Early Ming graves in the Philippines, but some eight or ten specimens were of unique types not heretofore known from Philippine sites. More than half of the pieces were Chinese, but about 25 per cent were Sawankhalok, and the remainder probably Indo-China, including several good specimens of the special "red-bottomed" variety. All probably came from some four or five accidentally excavated sites in the region between Makassar and the head of the Gulf of Boni. From Muto's description of the area, it is obvious that many old burial-sites and village-middens exist there, awaiting future systematic exploration.

Many good Ming and pre-Ming ceramic specimens from Celebes and the Moluccas also existed before the war in the Batavia Museum. My notes on them were either destroyed or misplaced during the war, and cannot be found at present. It is known, however, that Early and Middle Ming Chinese types, and a considerable number of Sawankhalok and Indo-China pieces, greatly predominate.

Historical records and monumental remains.—The oldest known image from Celebes (and one of the oldest from the entire Malay Archipelago) was found at Sikendang, and removed to the Batavia Museum in 1933. It was studied by Dr. F. D. K. Bosch and dated in the 2nd or 3rd century A. D. It seems to be contemporary with the early Hindu settlement at Kutei, on Borneo, just across the Makassar Strait.

In addition to the huge stone burial-urns in Central Celebes, some very interesting stone monuments have been studied and photographed by Hans Overbeck, in the Minahassa Peninsula. However, most of them seem to date from the early Dutch period in the 17th century. Many are carved with animal and human figures in various postures.

The Bugis genealogies have been recorded and translated into English by Hans Overbeck, but are difficult to interpret. Many ancient historical chronologies and annals from both Celebes and the Moluccas were published by John Crawford in 1820; but something is radically wrong with his dates, which often run back to the 12th century or earlier. The material is valuable, and needs critical re-study in the light of modern knowledge.

Some Moluccan natives were removed by the Spaniards from Ternate to Cavite Province, in Luzon, in the 17th century. Their descendants are still here, and before the war possessed some important records. The old Balagtas Will of 1589 also contains important data on the pre-Spanish relations between the Moluccas and the Philippines.

It is also believed that tobacco (introduced by the Portuguese into the Moluccas probably prior to 1520) reached Mindanao from Ternate before 1530, and was known in Luzon before 1550. It is also believed that it may have been planted in the Sarangani Islands by the Villalobos Expedition, during their 5 months stay there in 1543. In any case, the Ming Annals record its being first brought from Luzon to China in the year 1550, 20 years before Legaspi's arrival in Manila.

Workers.—(As recorded under the preceding various items.) Also E. Belcher, P. Bleeker, Charles Darwin, R. van Eck, N. Graafland, F. Grabowsky, F. H. Guillemard, H. N. Moseley, J. G. F. Riedel, H. Spenser St. John, P. A. Tiele, Alfred Russel Wallace J. N. Wiersma, G. A. Wilken, N. P. Wilken, Bartolomé L. de Argensola, Albert C. Kruyt, J. Macmillan Brown, E. W. V. O. de Flines, Albert Grubauer, Walter Kaudern, J. Th. E. Kiliaan, H. C. Raven, B. A. G. Vroklage, H. O. Beyer, Mrs. Violet Clifton, and others.

CONCLUSION

A perusal of this paper as completed has shown that a few matters seem to require some comment; of first importance is the disproportionate treatment given to the central and southern Philippines as compared to Luzon.

There are three basic reasons for this: First, the abbreviated treatment given the northern provinces was found unsatisfactory, and a more detailed description of actual sites developed as we worked southward. Second, many Luzon areas—such as the Batanes and Babuyan Islands, Pampanga, Rizal–Bulakan (including Manila), and Batangas Provinces—

will require special papers describing the work in greater detail than is practicable in the present paper. And, third, due to their remoteness and the difficulty of checking data, our catalogs and notes concerning the Visayan Islands and Mindanao-Sulu work had been more fully written up than has been the practice with nearby Luzon areas.

As a consequence of the above facts, the southern islands and provinces received a somewhat fuller treatment than that accorded the Luzon areas, although the latter, in point of specimen quantities and informative work done, are the most important. It is expected to balance this inequality, in the future, by a considerable number of special papers on the Luzon areas and on certain specific sites; or it may even be possible to publish the full catalogues of the Rizal-Bulakan and the Batangas Collections. This is particularly important in the case of the Rizal-Bulakan Collection, around 75 per cent of which was destroyed during the war. The full records of the work, together with existing photographs or drawings of destroyed specimens, should be assured of permanent preservation through publication.

While the Luzon areas most need full publication of the work at specific sites as has just been intimated, future publication for the Southern Islands area should be of a somewhat different nature. What is most needed there is first a general interpretive study, comparing the work done in different islands and areas and working out an overall picture of culture distribution and migrations. Particularly, also, the differences between coastal and inland cultures, and the definition of certain specific migration routes throughout the islands.

This brings up a second comment on the contents of the present paper, in relation to a future mapping of culture types and phases. It has not been practicable in the past to carry out any general mapping of prehistoric culture distribution, precisely for lack of such a compilation of data as the present paper attempts to supply. It should now be possible, when time is available for the work, to make up a general map showing, for instance, the distribution of Stone-Age culture phases throughout the Isalnds, so far as they are known up to the present date. Similar charts might then be prepared for Bronze- and Iron-Age cultures, and for the various phases of the Porcelain Age; as well as for such special subjects as jar-burial distribution, burial-cave use, native and

imported pottery distribution, etc. I have no doubt but that many interesting general facts, not now known or properly understood, would be brought out by the compilation of such maps.

Furthermore, I am beginning to envision a second compilation, along similar lines to the present one, to be entitled an "Outline Review of Philippine Ethnography"—but this is a much more serious task, and no present predictions can be made concerning it. However, if such a compilation should prove ultimately possible, we would then have a real picture of Philippine cultural history, both past and present, that would furnish the source material for many volumes of culture interpretation and historical development. (The chief difficulty that bars present consideration of such a compilation is the lack of any truly adequate ethnographic bibliographies, either by provinces or by ethnic groups. The National Language Institute and Prof. Gabriel Bernardo, of the University of the Philippines, had both made good progress with such bibliographies prior to the war, but practically all of their material was destroyed. At the present time my own collection possesses from 80 to 90 per cent of all such material available in the Philippines.)

Lastly, I wish to ask the co-operation of all users of the present work in revising or adding new data to the present record. Many local discoveries or explorations have doubtless escaped my attention; and any notice of such will be greatly appreciated. Communications may be addressed to me personally or simply to the "Department of Anthropology, University of the Philippines." It is expected that additions to the present "Outline" may be published from time to time in the future, as new data accumulate; and all communications of additional data will be duly credited to the senders.

A number of overlooked items have come to my attention after the bulk of the paper had already reached the printer's hands. Where it is not practical to insert such items in the galley proofs, they are added as an "Addendum."

ADDENDUM

[Additions and corrections to the preceding sections.]

In the preparation of a paper as lengthy and as full of detail as the present one is, it was perhaps inevitable that some important items would be overlooked or incorrectly recorded. Minor corrections and additions have been made in the galley proofs, but some items are too lengthy or unwieldy to warrant insertion in that manner. It has therefore been decided to combine all such material in the present "Addendum," which is to be considered as an integral part of the regular text. The various items have been arranged in the same order and with the same numbers for the different geographic areas as those used in the body of the paper—and this section will be kept open for late additions until the remainder of the paper has undergone final proofreading.

The chief known lack in the paper as it now stands is the absence of the full site-list of the Michigan Expedition, and of data on certain local or private explorations which are known to have been carried out in certain localities but concerning which no reliable information has yet been obtainable. Doubtless a number of references in the older literature have also been overlooked, and the present shortage of library material in Manila makes a proper check-up doubly difficult. I therefore ask indulgence for the shortcomings of the present work, and can only express the hope that it may be possible to remedy some of them, in a future supplementary paper when sufficient additional data become available.—H.O.B.

6. *Batanes Islands:*

Jar-burial culture.—Before the war Gilbert Perez possessed one of the largest and best preserved of the Uyugan burial jars (over 30 inches in diameter); while Montenegro turned over to me the three other best specimens excavated at Itbud. All of them were broken up or destroyed during the war, but I have some sketches showing their general form and dimensions.

Porcelain-Age remains.—The Hester Collection contains four very early whole pieces, excavated from one of Montenegro's sites as well as six other heirloom pieces of probable Spanish period dates. The four excavated pieces are all of Late Tang or Early Sung dates—one in particular being a unique small vase of definite Tang style (Plate 16, fig. 2).

14—b. *La Union Province:*

Porcelain-Age finds.—The Hester Collection contains a good celadon dish (with two molded fish in high relief on the inside center), of undoubted Sung date, which was accidentally excavated near San Juan, La Union. The specimen was obtained from Alejo Regasa in March, 1936; and from his description of the site it seems evident that one or more land-burials of the 12th century or earlier exist in the field where the dish was turned up.

15. *Benguet Subprovince:*

Burial-cave remains, etc.—Luther Parker, in his lengthy illustrated thesis on "The Early Bisayans," devotes a considerable section to a discussion of the burial-caves and niches of Benguet, and to the wooden coffins and other remains which he found there. He compares them with the burial-caves of the Visayan Islands.

18–a. *Northern Tayabas (Quezon) Province (including Polillo Island):*

Stone-Age remains.—The late Richard C. McGregor saw a typical Neolithic stone adze in the possession of a native in the interior of Polillo Island, while he was collecting birds there about 1905, but was unable to obtain it. He learned that such implements were known and highly valued as charms among the people there, who called them *ngipin kulug*, "thunder teeth."

24. *Bulakan Province:*

Heirlooms of the Spanish period.—The Hester Collection contains a very interesting dark-blue glazed jar, of South China provenance and probable 17th or early 18th century date, which was found as a treasured heirloom in a small barrio near Bulakan town, in June 1935. A similar piece, from an uncertain source, exists in my General Philippine Collection; while the late Eugene de Mitkiewicz found another in Pampanga, which is now in the W. Cameron Forbes Collection in Boston.

These three specimens represent the best work that I have seen from the Shekwan factories, near Canton; and have a thick varicolored glaze that seems to change color in different lights in much the same manner as certain special types of variegated silks.

26. *Manila City:*

Porcelain-Age remains.—Two exceptional specimens, both found in the deep excavations made when the S. J. Wilson and Trade and Commerce buildings were being built on Juan Luna Street (our Area EE–10), are worthy of special mention.

The first specimen, found at a depth of about 10 feet (under the Trade and Commerce building), is a whole molar tooth weighing nearly 15 kilos from *Elephas maximus* (*indicus*), the "giant Indian elephant." The specimen has been positively identified by Dr. Ralph von Koenigswald; and as the area where it lay has been under water for many centuries, it is well

preserved. By the associated pottery, etc., it can be dated back at least to the 16th century, if not earlier.

The Bureau of Science formerly possessed a photograph of a somewhat similar tooth (fragmentary only) that had been excavated on the Luneta, near the sea-wall, but it may have been originally dredged up out of the Bay. This specimen seemed to have been partly fossilized, and may have been older than the present one. Another related find was the broken half of an elephant tusk, excavated in the Santa Ana Site. Just how these three specimens came into the Manila area can now be only a matter for conjecture.

The second of the two exceptional specimens mentioned in the first paragraph above is a curious small green glazed jar, found at a considerable depth under the S. J. Wilson building (about 2 meters below the street level) in January, 1937—and later acquired for the Hester Collection. By associated ceramic fragments the piece seems to have lain in a deposit of 15th or early 16th century material; but what makes it most interesting is that the vessel is of a style heretofore known only from the early Sung and Tang periods. However, the known Sung and Tang pieces are all black or brown glazed, whereas the present one is covered with an opaque green. It is thus either a later copy of an early style, or a genuine early piece of unusual coloring (the type of green and paintlike quality of the glaze suggesting the Tang period). In the latter case, the specimen would likely have been an heirloom piece brought to Manila in the 16th century by an early Chinese resident of Binondo. The undamaged condition of the little jar indicates that it fell in the water and was covered with silt.

The considerable number of whole ceramic pieces found in this area indicates that the houses were built over the water. This is definitely proven by the great number of piles found at various depths throughout the EE–10 area and vicinity. The small forest of pile-stumps indicates many generations of pile-built dwellings within the area.

36. *Mindoro Island:*

Literary and historical survivals.—During the first six months of this year Harold Conklin has collected more than three hundred Mangyan manuscripts in the old syllabary—mostly inscribed on bamboo strips and cylinders, but in some cases on lime-tubes, musical instruments, and the like. His collection of old songs, traditions, and magic notions and formulae is especially good. Some interesting fossils and a large ethnological collection were also secured. (Since July he has transferred to Palawan Island, where he is carrying on similar work among the pagan Tagbanuas.)

My son, William G. Beyer, also visited southern Mindoro during April and May of this year—securing several good Mangyan lime-tubes, musical instruments, etc., inscribed with old songs; also a number of good fossils and other geological specimens.

39. *Tablas Island:*

Stone-Age remains.—During Edward H. Taylor's 1923 trip, previously referred to, he saw a black Late Neolithic stone adze in Odioñgan, belonging to a man named Luis Permelo who claimed to have found it at the foot of a lightning-struck tree, in the hilly interior of the Island. He would not part with it for any reasonable price.

Porcelain-Age remains and burial-cave explorations.—Dr. Carl E. Guthe explored at least two caves on Tablas Island in 1923 or 1924, and has described one of them. This is a fissure in the limestone cliffs, about 150 feet above the highwater mark, near the northeastern point of the Island, and is frequently heavily washed by rain-water coming down the fissure. He estimated that about six burials had been placed in the fissure at various times, causing a deposit of ceramic sherds and other objects in an area about 5 or 6 feet long by 4 feet wide, to a depth of about 18 inches. The following specimens were obtained there: 1 green, 3 grey, 17 blue-and-white, and 1 black-and-white ceramic specimens, 9 pieces of dark jars, 1 overglaze decorated fragment, and 1 of native pottery; 2 skeletal; or 35 specimens in all. This list would indicate that the burials were all of the Ming period, and none earlier than the 15th century.

Doctor Guthe also visited one or two caves in Romblon Island, but gives no data concerning them.

41. *Masbate Island:*

Porcelain-Age remains, ancient mines, and cave-explorations.—Dr. Carl Guthe records ten sites as having been investigated in Masbate, of which six were caves, two burial-grounds, one isolated land-burial, and one miscellaneous or doubtful. Three of the most productive sites have been described to some degree in published reports, and the data may be summarized and interpreted as follows:

First, a site at an old placer gold mine on the eastern shore of Port Barrera, northwestern Masbate. Ancient gold-workings were found here, where a vein outcrops on the southern exposure of the hills. Below this outcrop was a large talus-slope, in which many ceramic fragments and other evidences of ancient inhabitation were found. Doctor Guthe and his party spent several days there in 1923, and secured the following midden material: 1 skeletal specimen; 3 metal objects (two of iron and one of copper or bronze); 6 stone artifacts, and one shell ornament; 4 green, 1 grey, 2 white, 30 blue-and-white, 2 black-and-white, and 3 overglaze ceramic fragments; 3 pieces dark jars, 2 of native pottery, and 2 miscellaneous objects; or 60 specimens in all. The general evidence of the material indicates a Middle or Late Ming site.

Second, a site in the extreme northwest tip of the Island—accidentally found in 1923. This consisted of one interesting jar-burial of the early dragon-jar type, containing the cleaned bones of an adult and other objects. The jar was greenish-

brown glazed, and covered by a broken celadon bowl; while under the jar there was a stoneware bowl with a badly disintegrated glaze. The teeth found in the jar were particularly interesting, as the four upper incisors had all originally been decorated with gold plugs, two of them still having seven plugs or small disks in each. They have been illustrated in Doctor Guthe's paper on gold teeth.

This burial shows close kinship to those in the Hacienda Ramona Site in Pampanga Province; and the date cannot be later than the Yuan period (13th or beginning 14th century). The possibility of an earlier date depends entirely on the characteristics of the dragon jar, which are not stated. (If the dragons are archaic and high up on the shoulder of the jar, it may be pre-Yuan; if on the contrary they are large and low down in the middle of the jar, the specimen cannot be older than late Yuan or Early Ming—say 14th century.)

Third, a site consisting of a small cave or rock-shelter, located near the town of Malibon, in the northwest tip of the Island, just a few miles from the jar-burial described above. Decayed fragments of a wooden coffin, sizable pieces of a glazed dragon-jar, disintegrated skeletal remains, monochrome stoneware bowls, and pieces of unglazed jars were all mixed together indiscriminately on the cave floor. Screening the deposits in several parts of the cave brought to light bone beads, points of deer-antlers, a thin gold disk with an embossed design, and 70 miscellaneous human teeth of which three had been ornamented—one being empty and the other two having thin gold plugs still in place. The impression given by this material is that there were two types of burial of different dates. The unglazed jar-fragments, bone beads, deer-antlers, etc., suggest Sung or earlier; while the coffin and dragon-jar fragments, with the gold teeth and embossed ornament, are doubtless Yuan or beginning Ming.

Importance of Masbate.—The above finds, added to the long list given in the body of this paper, emphasize again the great importance of Masbate Island as a field for future archaeological work. Neolithic, Iron-Age, ancient mines, and both early and late pre-Spanish Porcelain-Age deposits, have all been amply demonstrated. The productive territory covers several extensive areas, most of which have as yet been very inadequately examined. It seems to offer ideal territory for a systematic expedition of some magnitude, prepared to spend at least a year or two in the work. (Also see page 367.)

42. *Samar Island and Province:*

Stone-Age remains.—Since closing the body of this paper, I find that in November, 1924, Dr. Carl Guthe sent me sketches and measurements of two interesting stone implements from Samar (no definite localities given); while in May, 1931, Prof. J. Ralston Hayden sent me a photograph and full measurements of a polished Middle Neolithic adze-gouge found in a Samar

cave by Dr. J. W. Chapman, of Silliman University, Dumaguete, Negros. Still later, on October 19, 1934, Dr. Robert B. Silliman brought that implement together with another smaller Late Neolithic plain-backed adze, found in the same Samar cave, to Manila for study and identification. Good drawings of both specimens in four positions, natural size, were made at that time by Miss Natividad P. Noriega. The specimens were returned to the Museum at Dumaguete, and their subsequent fate during the war period is not yet known.

One of the two pieces sketched by Doctor Guthe is evidently a true late palaeolith, of a modified cleaver type, made of flint or a flintlike quartz; and is a little over 2 inches long by 1½ inches broad. The other piece is flaked or chipped from a hard limestone, and seems to be more in the nature of a protoneolith, about five inches in length.

Of the two Neolithic Samar adzes from the Silliman Museum, the larger specimen is a gray adze-gouge over 6 inches long, by 2 inches broad and 1 inch thick; and it is made of a porphyritic andesite with shattered hornblende crystals. The smaller specimen is a mottled greenish-grey adze, also of porphyritic andesite with hornblende crystals. It measures 2¼ by 1¾ inches, and ½ inch thick.

The above described implements seem to indicate that both Late Palaeolithic and Neolithic cultures existed in Samar; and the exact location of the finds should be obtained from Doctors Guthe and Chapman.

Further Burial-cave explorations.—In addtion to the Suluan Island Site in southeastern Samar, which has already been discussed in the body of this paper, Dr. Carl Guthe also explored two burial-caves on small islands just off the west coast, and a little to the east of Daram Island 13 miles due south of Catbalogan. The material in both caves had been much scattered about, but they had both apparently been long used as places of burial. In addition to 34 teeth ornamented with gold plugs, disks, etc., and a great quantity of miscellaneous skeletal material, the following other classes of objects were found in the two caves: (1) Numerous fragments of porcellanous and stoneware bowls, dishes, and the like, all with celadon or other monochrome glazes (green, gray, or brown); also black-and-white decorated Sukhotai or Sawankhalok wares, blue-and-white Chinese and Indo-China wares, and fragments of stoneware jars with greenish-brown glazes. (2) Fragments of native pottery, both plain and decorated. (3) Several iron tools or weapons, some of which seem to have had handles of deer-horn. (4) Numerous ornaments, including bracelets, rings, and beads of shell, stone, and gold. (Some filed and red-stained teeth were also found, in addition to those with gold pegs.)

While it is impossible to judge accurately without a personal examination of the material, it still seems quite evident that at least three culture-periods are represented by the finds in

those two caves: A Late Iron Age, an Early Sung, and a mixed Yuan-Early Ming seem pretty clearly indicated. (Other minor culture divisions might well appear on closer examination.)

43. *Leyte Island and Province:*

Stone-Age remains.—In April, 1941, I received from Rodrigo O. Velez, of Cebu, a polished black stone adze that had been accidentally excavated some years previously in Ormoc, Leyte; and had been kept during the intervening time in the Velez Collection at Cebu. All three of the adzes so far obtained from Leyte are early Late Neolithic types, with plain backs or only slightly shaved transitional butts. Of the three, two are of black basalt, while the third is of a grey stone material not yet identified.

44. *Bohol Island and Province:*

(Since completing the main part of this paper, several new items have come to light—adding to or clarifying previous Bohol data. The most important are listed below.)

Stone-Age finds.—The sketch of a possible palaeolith from Bohol, sent to me in November, 1924, by Dr. Carl Guthe, has been located. It appears to be a well-flaked late Palaeolithic or Mesolithic specimen, of roughly conical shape and about one inch in base diameter. The material is not stated, but it has a polished sheen like jasper or chert. It was found in the excavations at the Sukgang cave, east of Loay.

In the same cave two Middle or Late Neolithic adzes, rather thick and made of a dark polished stone, also turned up. The edges of both were somewhat chipped or broken. (As they had already been packed away, no sketches of the adzes were sent.)

Additional burial-cave find.—In the spring of this year (1947) Governor Eutiquio Boyles, of Ubay, Bohol, reported to Dr José Feliciano, of Manila, that an interesting burial-cave containing wooden coffins with skeletal and other remains, had been found at Pupug barrio, Mabini, Bohol; and suggested that something be done about it. (Up to present writing no attempt has been made to remove the remains; but the Natural History Museum may later send a qualified man there.)

Porcelain-Age sites and finds.—The important Tagbilaran Site, investigated by E. D. Hester in 1939, has already been described in the main part of this paper; but it is now possible to give further data on three other interesting Bohol lots in the Hester Collection.

The first lot consists of two celadon dishes of fine quality, obtained for Mr. Hester by Pedro Menguito in March, 1934. They were the result of accidental excavations in or near Maribohok; and at a later date Menguito obtained several other good pieces in that vicinity—both for Mr. Hester and for myself. The largest celadon is nearly a half meter in diameter, and bears a good-quality floral scroll design. It is probably of Yuan or Early Ming date.

The second lot consisting of six good ceramic pieces, all excavated in the village of Maysáan, was obtained through the agency of the late José Crespo, then chief-engineer of the S. S. "Panay." All of the pieces are monochromes of Chinese and Indo-China origin, and appear to date all or mostly from the 13th century. It seems evident that several burials of the Yuan period are located in or near Maysáan village.

The third lot, also obtained through Crespo in November, 1934, consists of three pieces found in Baklayan, Bohol. All three pieces are blue-and-white ware of the late 14th or early 15th century; and one of them is a very unique water-vessel in the shape of a domestic fowl, with the head and tail representing spout and handle, and with a further peculiar modification of the hole-bottom base. One of the three pieces (a medium-small jarlet) is definitely akin to the "red-bottomed" group, of probable Indo-China origin.

46. *Cebu Island and Province:*

(Also in the case of Cebu, which is our most intensively explored area south of Luzon, a number of important items were overlooked. Part of them were with a group of mislaid papers recently located, after the main part of the present work had already been sent to the printer.)

Stone-Age remains.—In 1874–1875 Dr. J. B. Steere made a scientific collecting trip through the southern Philippines, and has the following note concerning an old Spanish priest at Carmen, Cebu: "The old man, after a long search, found a curious stone axe which he had found when digging in the hillside upon which the church and convent stood, along with gold beads, a Chinese cup, and human bones. This was the first time that I had seen anything that told of an earlier occupation than the present one."—(Note furnished me by the late Prof. J. R. Hayden.)

Porcelain-Age sites and finds.—In addition to the data given in the body of this paper, it is now possible to add three important items concerning early finds and collecting activities:

First, in tearing down some old walls in 1843 at the town of Cordoba, on Mactan Island, a remarkable small bronze image of the Hindu god Siva was found; later presented to the museum of the Ateneo de Manila, and destroyed by the Ateneo fire some years before the war. It was identified in 1912 by Dr. G. P. Rouffaer—at which time I had it photographed and measured. It probably dates from the Madjapahit period; and it would be interesting to know the character of the "old walls" torn down a century ago, as it is possible that they may have been of pre-Spanish construction.

Second, concerning the important site on the hill above the Naga cement plant, I have examined two other small but interesting ceramic collections found there. One belonged to the late Alfredo Pardo de Tavera, and the other to Mr. Claude Russell. Considering their material and that in the Michigan Collection as a single lot, it appears that this site is wholy pre-Ming and

parts of it go back to a late Tang or very early Sung date. Two of the pieces are of pure white *pai-t'ing* ware, with embossed decoration; and nearly all of the specimens are among the finest Sung-type wares yet found in the Philippines.

Third, it is now possible to give some account of the Cebu material in the Hester Collection and brief notes on six of the sites represented. The total Collection contains over 500 ceramic pieces obtained from Cebu collectors or agents, but the great majority have no proper site-data or field-notes attached. However, the following site-notes for six small special lots are worthy of record:

(1) A good small green Lungchuan celadon dish of the special "tub-shaped" variety was excavated from a grave in the Guadalupe hils, just back of Cebu City, prior to 1933, along with a number of other good ceramic pieces acquired by Mrs. Robert Landon, of Cebu. Later, in 1935, Mr. Landon gave Hester two pieces said to have been found in the same area. One is also a tub-shaped dish of late Sung date, but the other represents a much later site, being a Sawankhalok piece of 15th or early 16th century date. It is probable that there were two sites in this locality—both excavated by Landon's employees.

(2) A large grey-green celadon dish with fluted sides, of late Sung or Yúan date, was excavated in October, 1933, from a single land-burial site in the barrio of Pongwa, Cebu, and was obtained for Hester by Pedro Menguito in March, 1934.

(3) A small tub-shaped green celadon dish, also of late Sung or Yúan date, was excavated in Bantayan, and obtained for Hester by Pedro Menguito in March, 1934. A number of other good specimens in Manila collections have come from the same area in which this piece was found.

(4) Another tub-shaped dish with an olive-brown glaze was excavated in Lagtang barrio of Talisay, from a pre-Ming grave. It was obtained by Mr. Hester at the same time and in the same way as No. 3.

(5) An interesting melon-shaped jarlet with eight deeply molded lobes, covered with an opaque white glaze of Indo-China or Swankhalok type, was excavated at San Remigio, Cebu, and obtained for Hester in November, 1934, by José Crespo. Other pieces found with this specimen were taken by a Cebu collector. The date is 14th or 15th century.

(6) Three probable 14th century Siamese pieces all excavated from a single site in Dumanjug, Cebu, were obtained by Hester at the same time and in the same way as No. 5. One specimen appears to be the type called "Lopburi ware" by Phya Nakon; while the other two are normal early Sawankhalok pieces. (My own collection confirms the existence of a 14th century site in Dumanjug.)

49. *Panay Island:*

Burial-caves.—In 1914 Petronilo Cortez, head ranger of the Iloilo Forest Station, reported that in Balison barrio of Pilar, Capiz

Province, there exists a cave containing many old coffins of native hardwoods, and other remains. At that time five reasonably whole coffins were counted, and many broken and decayed ones. The local inhabitants fear to disturb these remains, which they believe go back to a very remote period.

Along the Panay Railroad, between Ventura and Buntog, there are very high cliffs of white coral rock, said to be honeycombed with caves. They can be reached from Dumalag, which contains, also, a very old and interesting church. It is not known whether there are burials in these caves or not, but the local people believe that they are inhabited by evil spirits and noxious animals.

51. *Kalamian Islands:*

Burial-caves.—In August, 1884, Alfred Marche visited a number of burial-caves on the small island of Peñon de Coron. He seems to have obtained chiefly skeletal remains, some pieces of native pottery, edible shell-fish remains, and a number of curious stone sinkers. Dr. Carl Guthe's finds on the same island have been already described in the main part of the paper. Marche has many interesting comments on the life, culture, and history of the pagan Tagbanuas, throughout the Kalamian Islands and Palawan.

56. *Surigao Province:*

Burial-caves and other remains.—About 1880 Dr. J. Montano visited the Magbulacao cave near Dinagat Island, northeast of Surigao town. Also the Tinagho cave on the islet of Taganaan; and two caves at Kabatuan, on Lake Mainit. He seems to have obtained chiefly skeletal remains in which he was particularly interested.

Among the specimens obtained by Dr. Carl Guthe from Surigao caves, he mentioned one unglazed piece that from his description seems to be a Khmer ware, similar to Babcock's Leyte jar, and my own finds from Bohol, Cebu, and eastern Negros. If so, this is the first report of this ware outside the central Visayas—Doctor Guthe's other mentions of it being seven pieces or fragments from Bohol, two from Cebu, two from east Negros, and one from Zamboanga. It is interesting to note how closely his earlier finds correspond, both in distribution and proportional quantity, with my later ones.

In another place Doctor Guthe speaks of "some very interesting winged clay pipes from eastern Mindanao"—doubtless referring to his finds in the Surigao caves. The only pipe in my collection that corresponds to this description is also from Surigao; see the Peters' Site near Placer, already described.

58. *Samal Island (in Davao Gulf):*

Burial caves.—About 1880 or 1881 Dr. J. Montano explored a number of burial-caves and niches on the small Malipano Island, on the west coast of Samal. He obtained chiefly skeletal ma-

terial. (See account in Chapter VIII of his "Voyage aux Philippines et en Malaisie," of which no copy is now available here.)

68. *Borneo Island:*

Stone-Age remains.—In 1935 Doctor van der Hoop published notes on a Neolithic barkcloth beater from Dutch Borneo, very similar to those found in the Philippines. (Illustrated in Plate 36, Catalogue of the Batavia Museum issued in 1941.)

In February, 1912, J. C. Moulton published a paper entitled "Some stone implements found in Sarawak," in Vol. I of the *Sarawak Museum Journal*, of which no copy is now available here. (Also see page 12 of the "Report on the Sarawak Museum for 1906," by J. Hewitt.)

The original report on Everett's palaeolith was printed in the *Proceedings of the Royal Society*, No. 203 (London, 1880) pp. 6–7.

A very important account of stone implements in Borneo is also contained in A. C. Haddon's "Headhunters, Black, White, and Brown" [London, 1901) pp. 327, 368–375, and fig. 33] (showing four Neolithic adzes and gouges). They are commonly regarded as toe-nails of the thunder god, and as having great potency as charms.

Miscellaneous data on Philippine caves and general finds.—The following data have been furnished by University students and instructors, on the presence of caves or other remains in their home districts. In most cases it is uncertain whether the caves contain human remains or not, but some of them are undoubtedly worthy of investigation.

(1) Julian Maguigad reported in 1921 that there are two good-sized caves in Cagayan Province, at a place called *Kira,* near Mt. Kalao. One of them was first discovered in 1906 by an American teacher named Duncan. It is in the face of a steep cliff high up on the mountainside, and can only be reached by a rope ladder.

(2) Francisco C. Domingo in 1921 reported that there is a very deep cave just northeast of Bauang, La Union Province, called "Lipit." It contains many bats. The local people fear it greatly, and will not enter it.

(3) F. C. Domingo also reports that near the towns of Mayantok and Santa Ignacia, Tarlac Province, there are many small and medium-sized caves. Some of them are as much as 8 by 12 meters in size. During the rainy season the Aetas or local Negritos often use them as shelters. Some also contain bats. (This group of caves should certainly be investigated.)

(4) José Bautista in 1921 reported that, in addition to the well-known Montalban cave, there are numerous other caves worthy of investigation in the Puray, Wawa, and Marikina River Valleys in Rizal Province. Some are known to contain only bats, but others are rumored to possess hidden treasures.

(5) The late Hammon H. Buck reported to me about 1922 that there are some interesting unexplored caves near Alfonso, in Cavite Province—especially to the south, in the barrio of Esperanza--

and that there are two interesting caves in the Talisay Ridge. (A Teacher in Talisay, married to Maria Laurel, knows their location.)

(6) Gregorio Sancianco in 1921, and several other students at later dates, have reported a number of interesting caves in Batangas Province. On Kamotas peak of Mt. Santo Tomas there is said to be an enchanted cave, about which a legion of stories are told. It is said that a coffin filled with precious stones was once obtained from it. There is a large cave at Altura, 6 kilometers from Tanauan; and another called *Malaking Pulo'* about 1 kilometer from the Altura cave. In Bagbag barrio there is the *Pintong* cave (about 9 kilometers from Tanauan); said to contain dishes and other utensils. It is also said to have been inhabited before the great eruption of Taal Volcano in 1754.

(7) Sometime in the early 1930s Captain Baja, of Lucena, reported seeing a number of undisturbed burial-jars in a cliff at the left entrance of the river mouth between Mulanay and Bondó, Tayabas Province. Broken ceramic wares, bones, and other objects were seen in the place. The nearest railroad station is Panson; thence to Mulanay by boat.

(8) In August, 1935, Dr. Francisco Gomez reported finding in a barrio of Naga, Camarines Sur, while cutting through a small hill, several pieces of (fossilized?) mammalian bone and one very large tooth, all at a depth of about seven meters in apparently undisturbed strata. The strata from the surface down are as follows; first thick black clayey soil, then soft adobe stone (*tufa*), then clay, then red sand, then rather hard adobe stone—and it is under this latter stratum that the bones were found. (This site should certainly be investigated.)

(9) The late E. E. Schneider called my attention to the fact that the well-known Bikol dictionary by Marcos de Lisboa (first issued in 1754; reprinted in 1865) has the word "*onto'*" for Neolithic stone axe, defining it as follows: "Los dientes delanteros de arriba." In other words, "teeth fallen from the sky."

(10) Students from Marinduque have reported as late as 1925 that the Talembang cave near Boak still contains bones, pottery, etc., in considerable quantity. Also the six small caves on the Tres Reyes islet.

(11) The late Prof. Otto J. Scheerer called my attention to a note in Montano's "Rapport" (Paris, 1885), p. 333, in which he states that polished stone axes are called "teeth of the thunder beast" on Mindanao; and that Sebastian Vidal y Soler had a collection of polished axes, adzes, chisels, and the like, obtained from that island. (It is known that Mrs. Vidal removed the family possessions to Philadelphia before the Spanish-American war, and spent her last years there—so it is possible that this collection is still in the United States.)

In closing the Addendum it may be of interest to point out that while the nature and length of the present paper has precluded the addition of an adequate Bibliography, nevertheless

such a work is in the course of preparation and the need of publishing it at an early date is fully appreciated.

The basic plan of the work, which must of necessity include several hundreds of titles, is to follow the same geographic arrangement utilized in the present paper—and to include under each serially numbered area all important or essential references, printed and manuscript, so far as knowledge of them is available here. Minor or inaccurate references, that contain little or no real information, will be intentionally omitted from the list. In other words, the "Bibliography of Philippine Archaeology by Geographic Areas" is indicated to be an essential supplement to the present geographic review of the material itself.

In listing important manuscript compilations, such as my two general works mentioned in the Introduction and the specimen catalogues, a full list of the included individual papers or chapters will be given. For this reason the list of "Philippine Archaeology" papers will not be added to the present already too lengthy production, and it should be looked for in the "Bibliography" which it is hoped will be published within the coming year. If feasible, some additional site-maps and supplementary notes to the present paper may be included at that time.

—(H. O. B., August 31, 1947.)*

* As the passage of this paper through the press has been considerably delayed, I am taking advantage of the opportunity to add the following six final notes to the page proof:

(1) *Pardo de Tavera Collection.*—At least 80 per cent of the collection of old Philippine ceramics, woodcarvings, manuscripts, photographs, etc., formerly owned by Dr. T. H. Pardo de Tavera, survived the war and is now in the hands of Mrs. Alfredo Pardo de Tavera in Quezon City. Especially notable are several excavated and heirloom pieces from Cebu and other Visayan Islands: Sawankhalok celadons, etc., from Marinduque caves (see p. 260); and, above all, the only known perfect specimen of "Manila Ware" from the 17th century San Pedro Makati kilns. It is to be hoped that this collection may be ultimately acquired by the National Museum.

(2) *Janse's finds at Calatagan in Batangas.*—The excavations and finds of Olov T. Janse, already briefly described on p. 245, have recently been made the subject of an illustrated article in the 1946 Annual Report of the Smithsonian Institution. As Doctor Janse's contacts here were almost wholly with administrative officials who were unfamiliar with the scientific work being carried on, it is not surprising that he makes some very incorrect statements concerning Philippine Archaeology in general.

While the work at Calatagan was systematically done, it is to be regretted that Doctor Janse made no attempt to familiarize himself with what had been previously accomplished in Philippine Archaeology or to examine even superficially the collection of more than half a million classified specimens then stored up in Manila—nor the more than 20 volumes of exploration records and horizon-determinations that were accessible to any qualified scientist. In fact, the identification and dating of a majority of his finds were

done by myself at the request of the Director of the National Museum.

While publication of archaeological results has been admittedly slow, in the Philippines, the amount of work actually accomplished is amply demonstrated by the present paper—and as more detailed site-studies are published from time to time, the results can easily speak for themselves.

(3) *Additional notes on Stone-Age finds from Masbate.*—The following old notes on Masbate stone-implements and cave-remains, by Wilbur Wilson, have recently been recovered: "In 1903, three large stone mortars and three stone pestles were found in one of the ancient mine workings at Rio Guinobatan. The largest mortar was nearly 3 feet in diameter. Some grooved hammer-stones, mostly spherical, were also found that year in the same locality— the biggest being 6 inches in diameter, completely encircled by a groove ½ inch wide."

In May, 1911, a polished black stone adze, about 2 inches wide at the blade, was found by Wilson in the north Batuñgan cave, in the same area where Smith's later finds were made in 1920. Later on, three or four other stone implements (adzes and chisels) were found on the floor of the small room adjoining the larger cave. Wilson believes that still others might be found in one portion of the cave where a cave-in has covered a considerable section of the floor.

Wilson's notes further state that several interesting caves exist near San Isidro, Masbate; and another one on Captain Heath's ranch at Bugtong. He has also seen interesting remains in some caves on the north end of Ticao Island.

(4) *The Babcock Collection, from Leyte, Camiguin Island, and Lanao.*—Recent information on the fate of this interesting collection (discussed on pp. 275–276, 300, and 317, *ante*) has come to hand with Major Babcock's postwar visit to Manila as a member of the Veterans Administration.

While most of the smaller pieces in his collection were shipped or taken by him to the United States prior to the war, all of the larger pieces were left here—stored in a room at the Y. M. C. A. Apparently all of the latter (including the unique Khmer vase from Leyte) were destroyed or looted during the war, as he has not been able to find any trace of them. This constitutes a real loss to Philippine ceramic history—particularly as no adequate photographs or drawings exist.

(5) *Philippine Craniology.*—In 1901–1904 G. A. Koeze published his valuable *Crania Ethnica Philippinica,* giving detailed measurements and descriptions (and many illustrations) of 249 Philippine skulls from the Schadenberg Collection purchased by the Leiden Museum. Of these, nearly one-third were obtained from caves of archaeological interest (see Samal Island, etc.).

During the war a most interesting new work—entitled *Craneos de Filipinas*—was published at Madrid in 1942, the author being Francisco de las Barras de Aragon. This valuable production describes and illustrates the collection of Philippine skulls in the Anthropological Museum at Madrid—totalling 81 specimens from 17 provinces and islands. Of these, at least 19 skulls were found in caves of archaeological interest.

It is too late to now attempt an adequate discussion of the valuable data contained in these craniological works, which must be reserved for a future supplement to the present paper.

(6) *Bibliography.*—More than 1,100 titles have already been prepared for the Bibliography of Philippine Archaeology, mentioned on pp. 365–366, *ante.* The total titles are expected to reach about 1,500.

ILLUSTRATIONS

(Line drawings are by Manuel M. Santiago. Photographs are either from the Beyer or the Hester Collection)

PLATE 1

FIG. 1. Fossil stegodon tooth, from a Middle Pleistocene deposit at Site A, Rizal Province; natural size. (This deposit contains also tektites and early palaeoliths.)

2. Three early palaeoliths of chalcedony from Middle Pleistocene deposits in Rizal Province; × ⅓. (Sites A and B.)

PLATE 2

FIG. 1. Four typical Rizalites, or Philippine tektites, from the Lake District of Rizal Province; × ¾. (From a Middle Pleistocene deposit.)

2. One big Zambales–Pangasinan tektite, with rare type of radiating surface sculpture; from the Babuyan Site, near Zambales–Pangasinan border; × ¾.

3. One extra-large Bikol tektite, with deep grooving; from dredging operations near Paracale, Camarines Norte; × ¾.

PLATE 3

FIG. 1. Davao palaeolith of brown jasper, found by F. G. Roth in a gravel pit thought to be Middle or Late Pleistocene; × ¾.

2. Bulakan early palaeolith from Site W.

3. Rizal Province palaeolith from Site A; found with stegodon fossils and tektites; × ¾. (Chalcedony.)

4. Typical Late Pleistocene palaeolith, from Site G near border of Bulakan and Rizal Provinces. (Of flintlike chert.) Resembles certain European Chellean types, and certain cognate forms from the Pleistocene laterite beds of the Madras presidency in India.

5. A probable Late Pleistocene palaeolith of well-patinated obsidian; from Site 26 of the Rizal Province Lake District; × ¾.

PLATE 4

FIG. 1. A Mesolithic artifact of Hoabinhian type; from Site F on the Rizal–Bulacan borderline; × ⅔. (Of a tough quartzite.) This type common in Indo-China, but relatively rare in Luzon.

2. A probable Mesolithic flint artifact of the large implement type (but may be Late Pleistocene), from Site A, Rizal Province; natural size.

3. Eight Mesolithic semimicroliths of obsidian and chert; from the Lake District of Rizal Province; × ⅓.

PLATE 5

FIG. 1. Eight Mesolithic or Protoneolithic microliths of chalcedony, flint, and other translucent materials; all from Rizal Province, several sites; natural size. (In reversed position.)

2. Two Protoneolithic axe-adzes, ground at the blade only; both from Site C, Rizal Province; natural size.

PLATE 6

FIG. 1. Typical Early Neolithic adze, in three positions (face, edge, and cross-section); from Site 22, "Kalumpang," in the Lake District of Rizal Province; × $\frac{2}{3}$. (Of andesite, thickly patinated.) Closely related to the Early Neolithic of Bacson, Indo-China.

2. Rounded form of Early Neolithic adze, or chisel, in three positions as above; from Site A, Rizal Province; × $\frac{2}{3}$. (Of andesite, thickly patinated.) The "Walzenbeil" type of Heine-Geldern.

PLATE 7

Transitional form from the Early to the Middle Neolithic adze, in four positions (edge, face, cross-section, and ridged back); from Site W, Bulakan Province; about $\frac{1}{2}$ natural size. (Of andesite, thickly patinated. This is the earliest known form of the ridged adze.

PLATE 8

FIG. 1. Early type of shouldered adze, very rare in Philippines; from Tanauan, Batangas Province; natural size. (Of andesite, well patinated.) This type is best known from Assam, Burma, and parts of Indo-China.

2. Small disk of flinty quartz, with sharpened edges; from Tanauan, Batangas Province, and found with shouldered adze; natural size. Several similar specimens have been found, all from Batangas sites; but the type is known also from Hongkong.

3. A later type of shouldered adze, showing kinship to the shouldered bronze celt; from Batangas Province; natural size. (Of a fine-grained porphyry.) Only two shouldered axes are known from Rizal Province, and these both show kinship to Formosan and Celebes types rather than to the Indo-China and Batangas varieties.

4. A small thin chisel with a rare type of pointed butt; from Site C, Rizal Province; natural size. (All specimens on this Plate are regarded as Middle Neolithic types, some early and some late.) In reversed position.

5. Typical tanged adze from Batangas Province, of the type believed to be ancestral to the tanged adzes of the central and eastern Pacific Islands region; × $\frac{3}{4}$. (This type is scarce in the Philippines, being replaced by the "stepped" adze.)

PLATE 9

FIG. 1. Ten Neolithic flaked tools of obsidian (scrapers, points, knife-saws, and combination tools); from Early and Middle Neolithic sites in Rizal Province. Large numbers of used flaked tools of these types are found in Rizal, Bulacan, and Batangas Provinces; × $\frac{3}{4}$

2. The backs of two Late Neolithic trapezoidal adzes, showing early transitional forms leading up to the "stepped" adze; both made of fined-grained black basalt, the smaller specimen (from Ifugao) being thinly patinated and showing the earliest type of butt-shaving; about $\frac{2}{3}$ natural size. The larger specimen (from Bi-

nangonan, Rizal Province) shows a slightly deeper reaming out of the primitive "step." (About $\frac{2}{3}$ natural size.)

PLATE 10

FIG. 1. Six Neolithic flaked arrowpoints and spearheads, all from Rizal Province sites; natural size. (Three of obsidian, and three of chalcedony and flint.)

2. Three types of Late Neolithic nephrite spearheads of the polished variety; all from Batangas sites; natural size. (Eight different shapes exist.)

PLATE 11

FIG. 1. Six Late Neolithic adzes (all trapezoidal in cross-section), showing gradual evolution of the fully "stepped" form; all from Batangas sites; $\times \frac{1}{2}$. (Mostly of hard grey and black stones.)

2. Late Neolithic gouge (with cross-section), made of highly polished and very hard mottled violet-grey stone; from a Batangas site; $\times \frac{1}{2}$.

3. Small Late Neolithic adze or chisel of clear green jade, plain-backed; from a Batangas site, in San Felipe; $\times \frac{1}{2}$.

4. Polished block of clear green jade, about 7 mm. thick, being sawn in narrow sections for bead-making; from a San Felipe site, Batangas Province; $\times \frac{1}{2}$. (First step in manufacture of long cylindrical jade beads.)

PLATE 12

FIG. 1. Engraved grey stone block believed to have been used in printing designs on barkcloth, in the Batangas Late Neolithic period; $\times \frac{3}{4}$. (Some barkcloth beaters, with a special type of lining, were probably used as printers.)

2. Medium-sized adze of a fine quality of polished nephrite, partially sawn in two; from a Batangas site; $\times \frac{3}{4}$.

3. Fragments of four types of jade bracelets, two clear green, one yellow-green and one greenish grey); all from Batangas sites in the Cuenca area; $\times \frac{3}{4}$. (The third specimen from the top is related to a special type of Late Neolithic jade ornament, usually appearing as an earring or as an amulet-pendant, regarding which I am publishing a separate paper.)

4. Middle or Late Neolithic barkcloth-beater and printer; formerly in the museum of the Ateneo de Manila, where it was labelled as having been found in 1889 in use as an idol by the pagans of eastern Misamis, who believed that it had fallen from the sky; about $\frac{1}{6}$ natural size. (The "horned" type of beater is known throughout the Philippines, having been found in Luzon, Cebu, and Mindanao. Two other types, one straight-backed and one with a grooved body, are known from Luzon and Cebu only.)

PLATE 13

FIG. 1. The four whole bronze celts found in the Batangas sites; about $\frac{3}{4}$ natural size. (Two upper specimens were taken away by the Japanese during the war; but the two lower specimens are

still in the collection.) Closely related types have been found in Indo-China, Hongkong, and Celebes.

2. Reconstruction of the one bronze spearhead found in the Batangas sites, only about one-third of the specimen having been actually recovered; $\times \frac{1}{2}$. (Could have been a dagger blade?
3. Bronze grip from the handle of a dagger; from a mixed Bronze-Age and Late-Neolithic area in Batangas; about $\frac{2}{3}$ natural size. (Similar specimens have been found with Bronze-Age earrings and other jewelry, in Rizal Province.)

PLATE 14

Reconstruction of six decorated pottery vessels of the Early Iron Age; from Rizal Province Sites A, C, and H; about $\frac{1}{5}$ natural size. (This type of pottery decoration dates from the 2d century B. C. to the 2d century A. D., and is found in Celebes, the Philippines, Japan, Korea, and southern Manchuria. Some archaeologists believe that it originated in Asia Minor or southern India.)

PLATE 15

FIG. 1. Small Early Iron-Age vase from a land-burial near Calapan, Mindoro (see area No. 36 in text); about $\frac{2}{3}$ natural size.

2. Pottery disk, carved from a potsherd; from an Early Iron-Age grave in Site C, Rizal Province; $\times \frac{3}{4}$. (From two or three up to a dozen or more such disks are found in nearly every prehistoric Iron-Age grave. They are regarded either as grave toys or as symbols of primitive "money.")
3. Heavy gold earring from an Early Iron-Age grave on Hill No. 1, at Site A in Rizal Province; $\times \frac{3}{4}$. This type was found only in the graves of chieftains or wealthy men—the type in women's graves being of oval shape and smaller size. (All existing specimens were taken by the Japanese during the war.)
4. Green glass bracelet from the same grave as Fig. 3 above; about $\frac{2}{3}$ natural size. Evidence has been found indicating that this type of glass was manufactured at Site A.
5. Early Iron-Age beads from graves at Site A, Rizal Province; about $\frac{2}{3}$ natural size. Stone beads are chiefly of carnelian, rock-crystal, banded agate, and a few of amethyst and other semiprecious stones. The other beads are of green and blue glass (locally made?), and of red, yellow, and orange glassy pastes. Some of the holes in the earlier stone beads are very crookedly bored, usually starting in from both ends and often meeting irregularly.

PLATE 16. LATE TANG AND EARLY SUNG WARES—(9TH TO 11TH CENTURY).

FIG. 1. A fruits-shaped fluted small covered round box, made of a fine quality of Ying Ch'ing thin porcelain, covered with a thin bluish-green glaze; with an embossed inscription in Korean characters on the base that indicate a 10th or 11th century date for the piece; about $\frac{1}{2}$ natural size. Formerly in the collection of Mr. and Mrs. Kenneth B. Day; found in a land-burial site near the Cebu cement works at Naga, about 20 km. south of Cebu City,

associated with early Sung Ting ware and celadon pieces. (A similar piece exists in the Eumorfopoulos Collection in England.)

2. Small white-glazed porcelain vase, in the Hester Collection; found with other pieces of probable Late Tang date, in a grave excavated by Pio Montenegro in the Batanes Islands; about ¼ natural size.
3. Tiger's head of white porcelain covered with a thin bluish-green glaze of Ying Ch'ing type; found in an Early Sung-period site (Site E) in Rizal Province; × ½. Several other small images, representing human and animal figures in various positions, were found in the same site.
4. Late Tang or Early Sung bowl, with incised floral scrolls inside, under an unusual bluish-grey glaze; design and workmanship similar to certain early pieces found in Batanes and Sulu Provinces; about ½ natural diameter.

PLATE 17. TYPICAL LUNGCHUAN SUNG CELADONS OF THE 11TH AND 12TH CENTURIES

FIG. 1. Large Lungchuan celadon, dish, 14 inches in diameter, of good color and workmanship; from a land-burial in southwestern Cebu. (Twelfth century date.)
2. Two typical Sung celadon bowls; both from land-burials in southern Cebu; about ⅓ natural size. Similar types are known from North China and Korea—the narrow foot-ring and lotus-petalled sides being characteristic of the early Sung pieces. (Lungchuan body ware, and thick green glaze.)

PLATE 18. SAWANKHALOK BLACK-GLAZED AND CELADON PIECES OF 13TH AND 14TH CENTURY TYPES

FIG. 1. Four small vases or bottles of black-glazed and dark-brown glazed Sawankhalok stoneware; from the Hester Collection, all being found in land-burials in Bohol and southern Cebu; about ¼ natural size.
2. Sawankhalok celadon large jarlet or bottle, with two ears; from the Hester Collection, found in Cebu; about ¼ natural size. (Good specimen, with olive-green glaze.)

PLATE 19. FOURTEENTH-CENTURY SAWANKHALOK CELADON BOWL

Two views of medium-large Sawankhalok celadon bowl, with dark-green crackled glaze; from my General Philippine Collection, found in a southern Cebu land-burial; about ⅔ natural size. Black stand-ring on base is characteristic of all Sawankhalok wares.

PLATE 20. TYPICAL LARGE MING JARS

FIG. 1. A large brown-glazed stoneware jar, with two dragons in relief; found in 1885 in a limestone burial niche uncovered during a storm, in the mountains just back of Wak barrio, Balambang, Cebu Island. Design is partly filled with a lime deposit difficult to remove. When found, jar was covered with an engraved but considerably corroded silver plaque, which was later sold to a Chinese merchant. This specimen was collected in 1920 at Wak barrio by Eugene de Mitkiewicz, and is now in the W. Cameron Forbes Collection at Woods Hole, Massachusetts. It

is of late 15th or early 16th century date; and measures 28 inches in height.

2. Early Ming blue-and-white jar, excavated from an early Ming grave in south-central Cebu Province. Specimen is a little less than 20 inches high, and is of 15th century date—being covered with an elaborate floral design in a dark violet blue. (From my General Philippine Collection.)
3. A large brown-glazed stoneware jar with lionhead ears and incised dragon design, of 16th century or beginning 17th century Late Ming date and style. Some fragments have been found in caves, but usually jars of this type are heirloom pieces preserved in native homes. This specimen, which is 23 inches high, came from southern Cebu. (General Philippine Collection.)

PLATE 21. INDO-CHINA (?) AND EARLY MING CHINESE WARES OF THE 14TH OR BEGINNING 15TH CENTURY

FIG 1. Two interesting jarlets with unusual blue-and-white or black-and-white designs, belonging to the special "red-bottomed" group believed to have been made somewhere in Indo-China or South China. From the Hester Collection; found in Cebu or Bohol. (The large specimen, ⅓ actual size, is known in our notes as the "Forbes type.")

2. Two small square water-vessels (for the inkstand), with designs in a dark Mohammedan blue on the sides, and originally with molded archaic white dragons on top; originally from the Veles Collection, both having been found in early 15th century land-burials in Cebu; about ⅔ natural size. Fragments bearing designs of this type were the only blue-and-white specimens found in the 14th century area of Site B in Rizal Province—and they are regarded as among the earliest Ming blue-and-whites to be made.

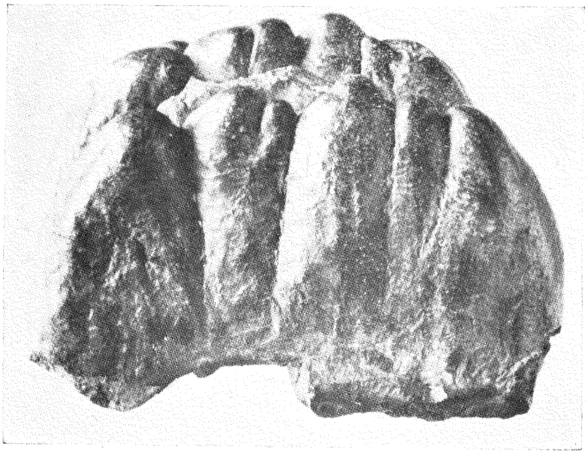
PLATE 22. A SPECIAL TYPE OF INDO-CHINA BLACK-AND-WHITE WARE OF THE "RED-BOTTOMED" GROUP

Top and bottom views of a small plate, belonging to the "red-bottomed" group, with black floral design under a finely crackled straw-colored glaze, and with five peg-marks on the upper side; believed to have been produced in Indo-China or in some unknown Siamese or South China kiln. Of 14th century date; found in a land-burial of central Cebu; about ½ natural diameter. The Shino wares of the Japanese were copied from this type.

TEXT FIGURES

FIG. 1. Map of the Rizal Province Archaeological Survey, covering sites found up to the end of 1929 (106 sites in all); 14 additional sites, recorded in 1930, not being shown here. (Copied in reduced size from the original 1930 blueprint, by Manuel Santiago.)

2. Archaeological map of Jolo Island, Sulu Province, showing 20 recorded sites found and partially explored by the late Capt. F. G. Roth. (Copied in reduced size by Manuel Santiago, from the original large map prepared by F. G. Roth and H. O. Beyer in January, 1940.)



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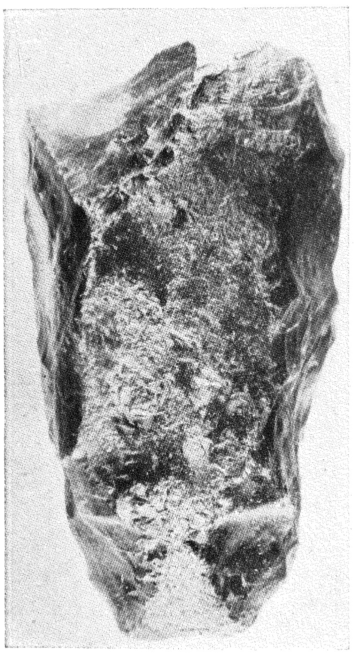

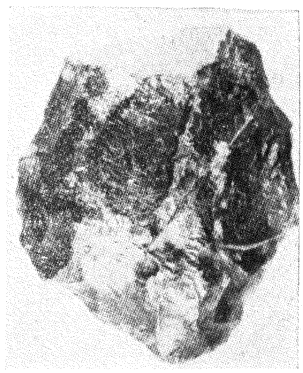

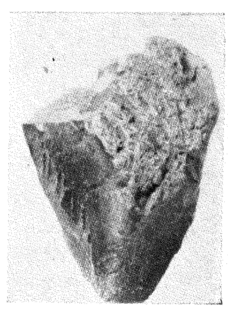

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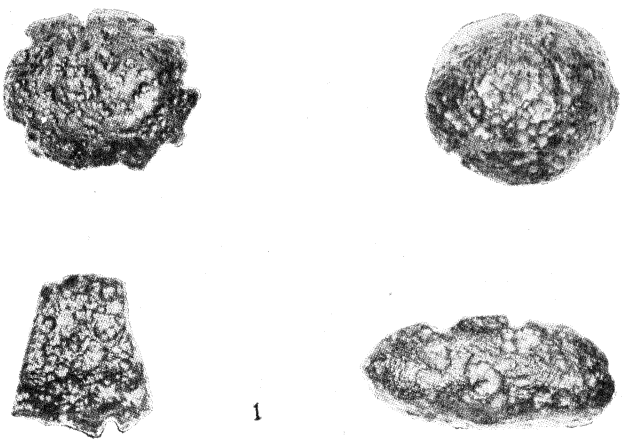
PLATE 1. MID-PLEISTOCENE PALAEOLITHS AND FOSSILS.



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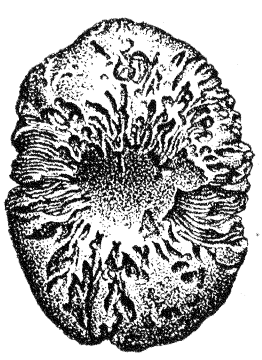

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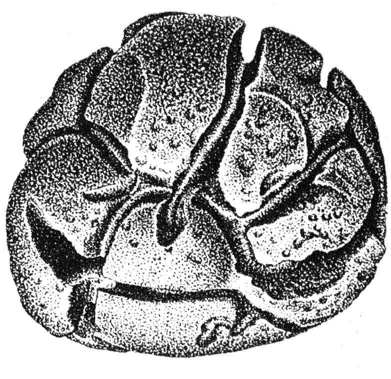

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PLATE 2. MID-PLEISTOCENE TEKTITES.

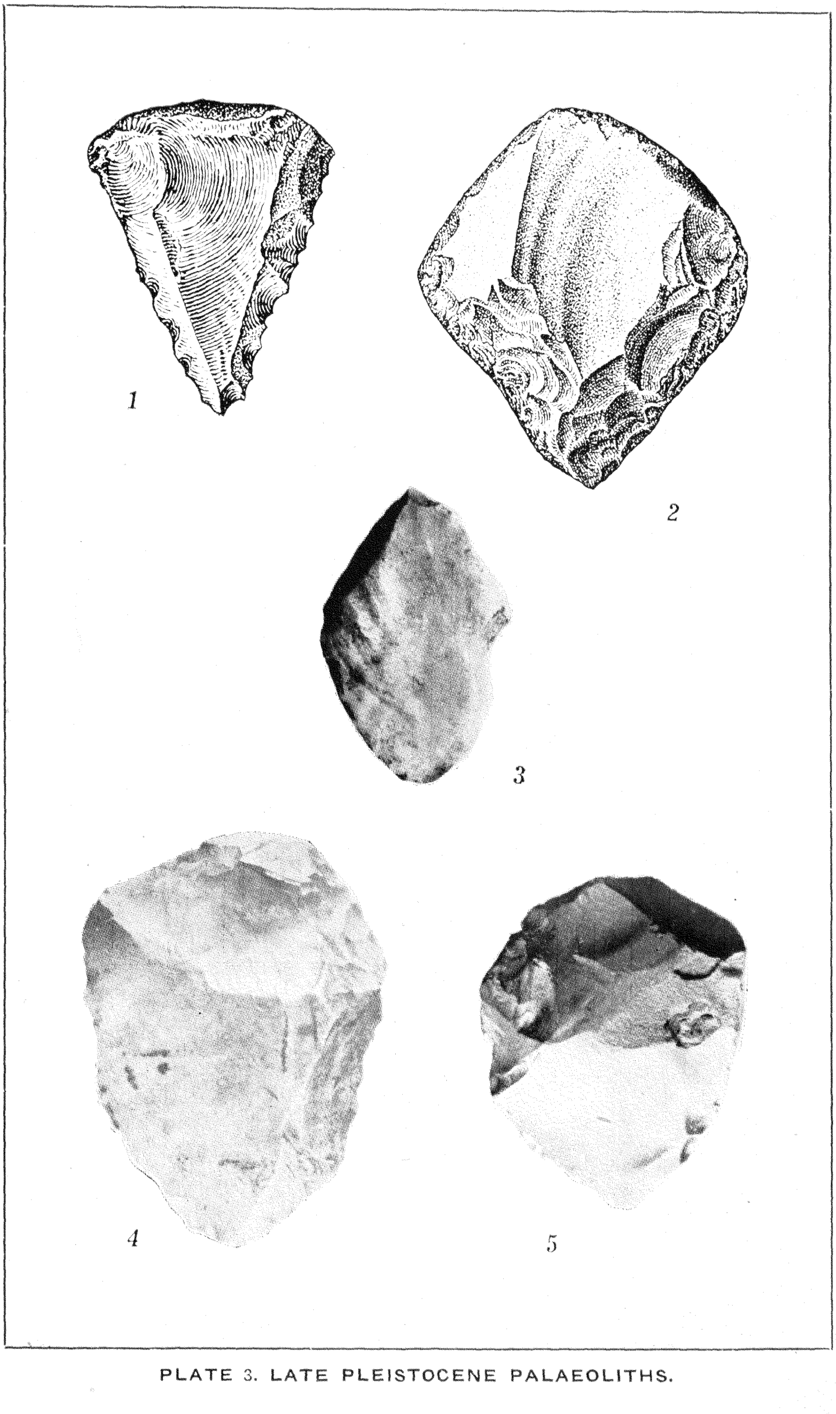

PLATE 3. LATE PLEISTOCENE PALAEOLITHS.

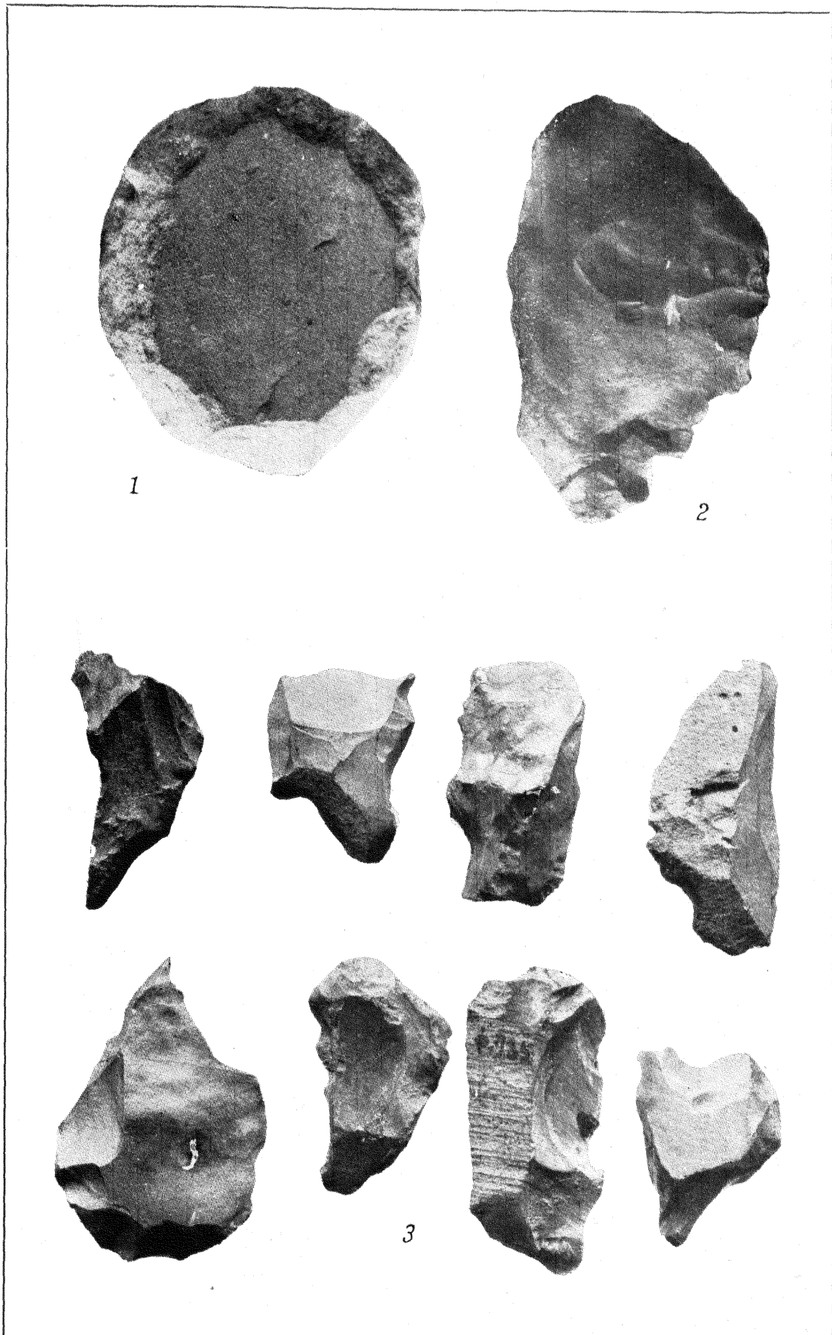

PLATE 4. EARLY POST-PLEISTOCENE MESOLITHIC ARTIFACTS.

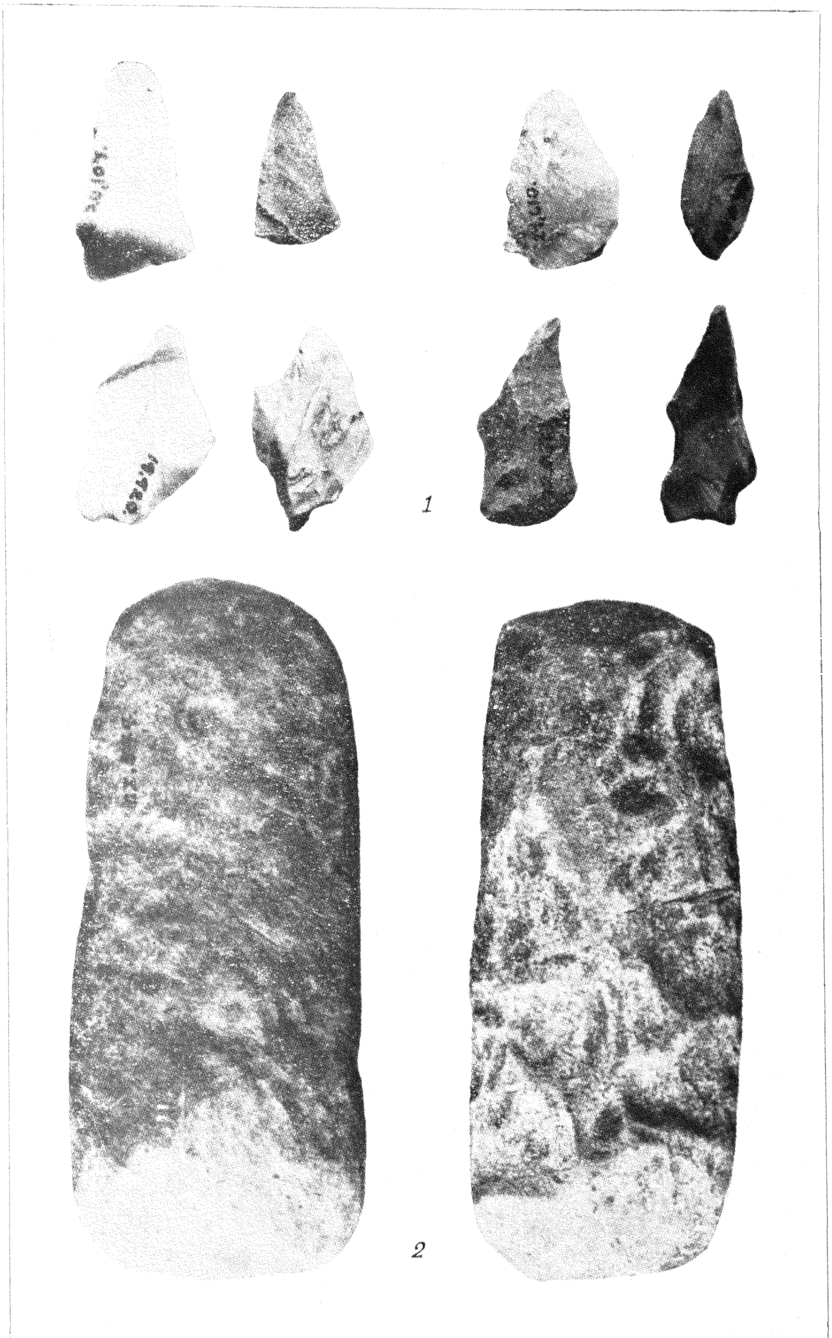

PLATE 5. LATE MESOLITHIC AND PROTONEOLITHIC ARTIFACTS.

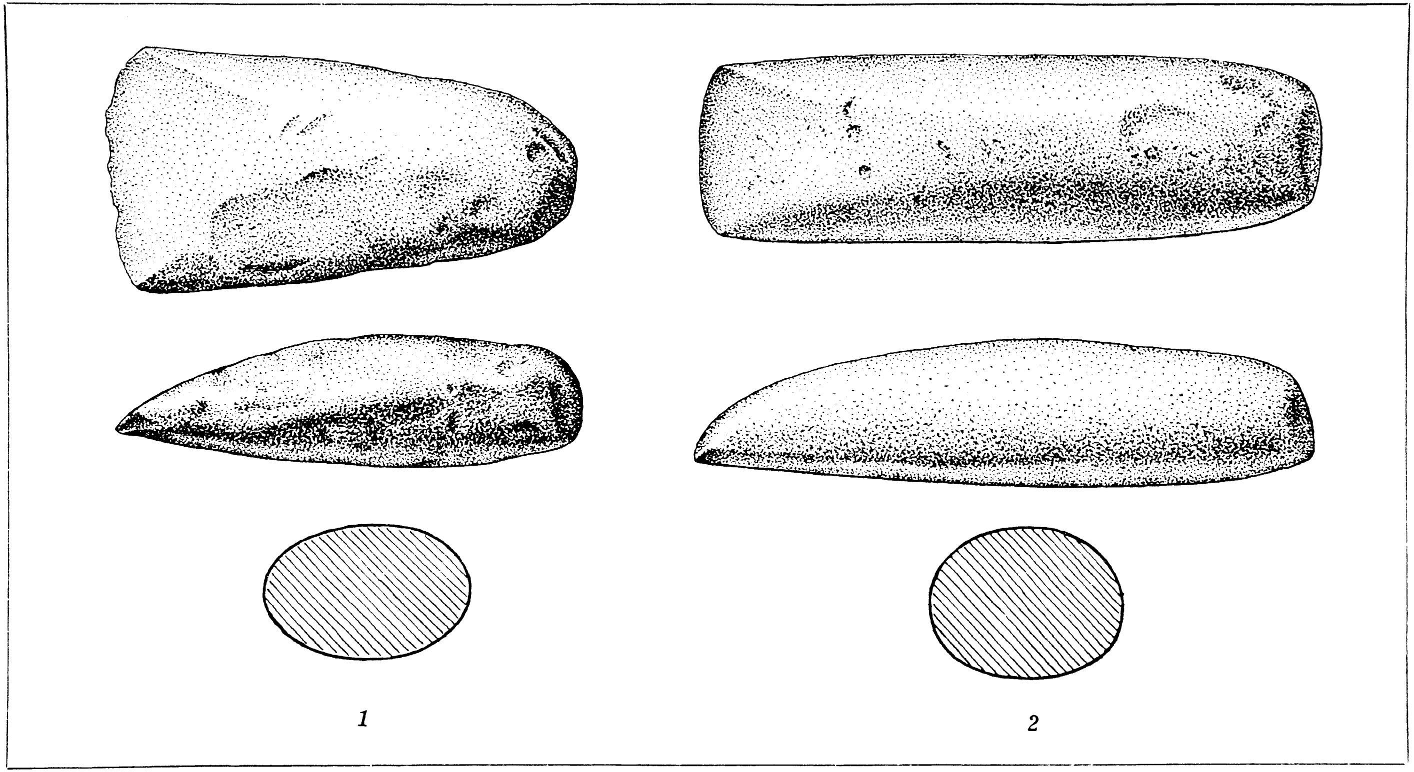

PLATE 6. EARLY NEOLITHIC ADZES.

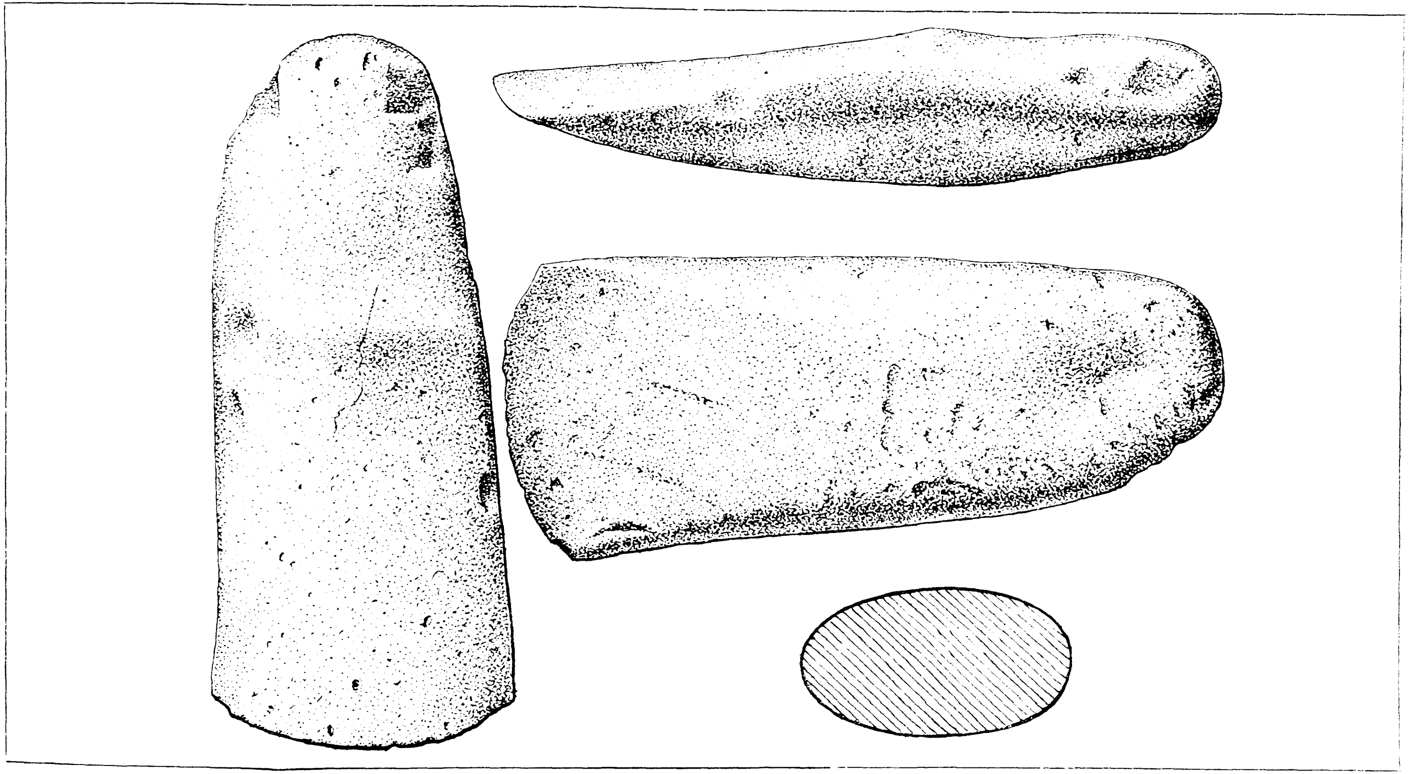

PLATE 7. TRANSITIONAL TYPE, FROM EARLY TO MIDDLE NEOLITHIC.

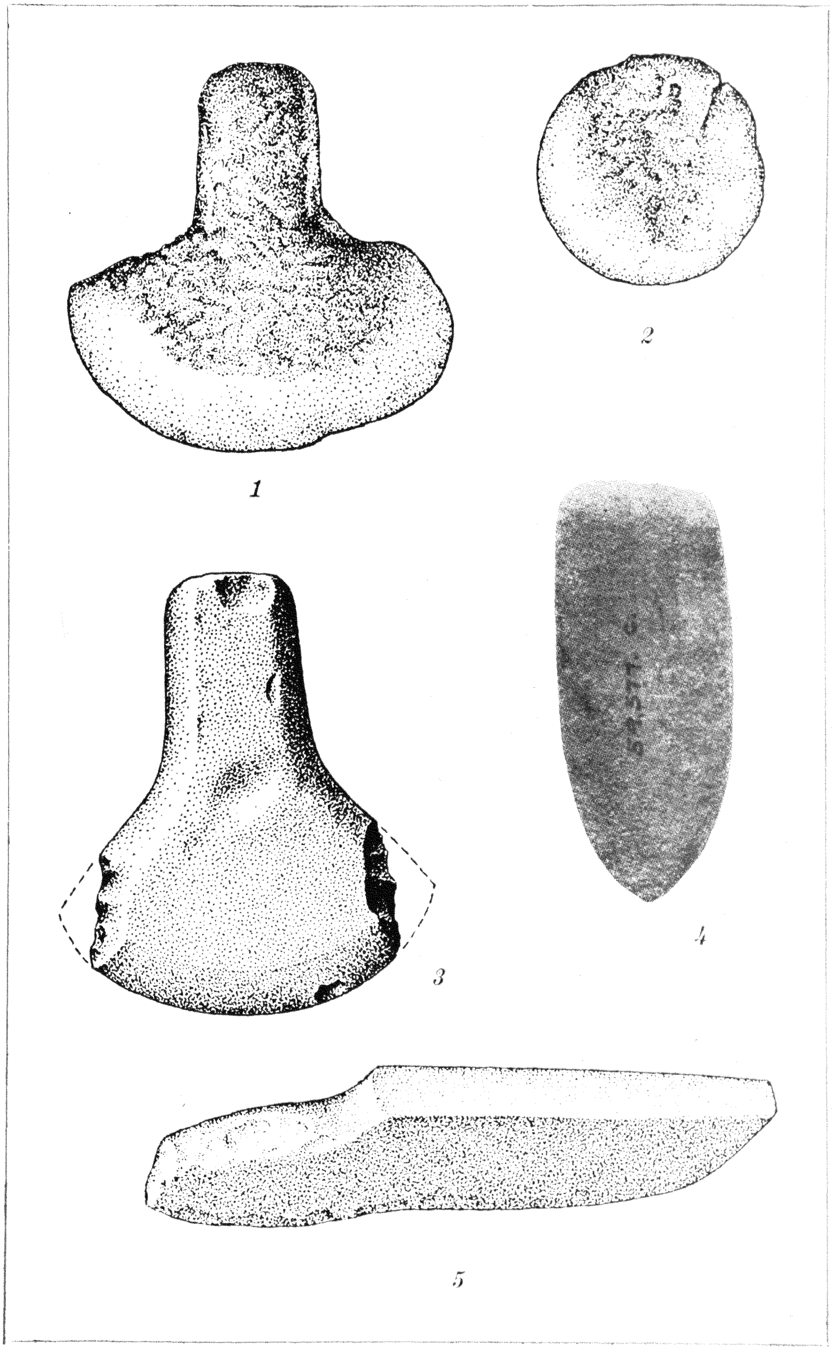

PLATE 8. MIDDLE NEOLITHIC TYPES.

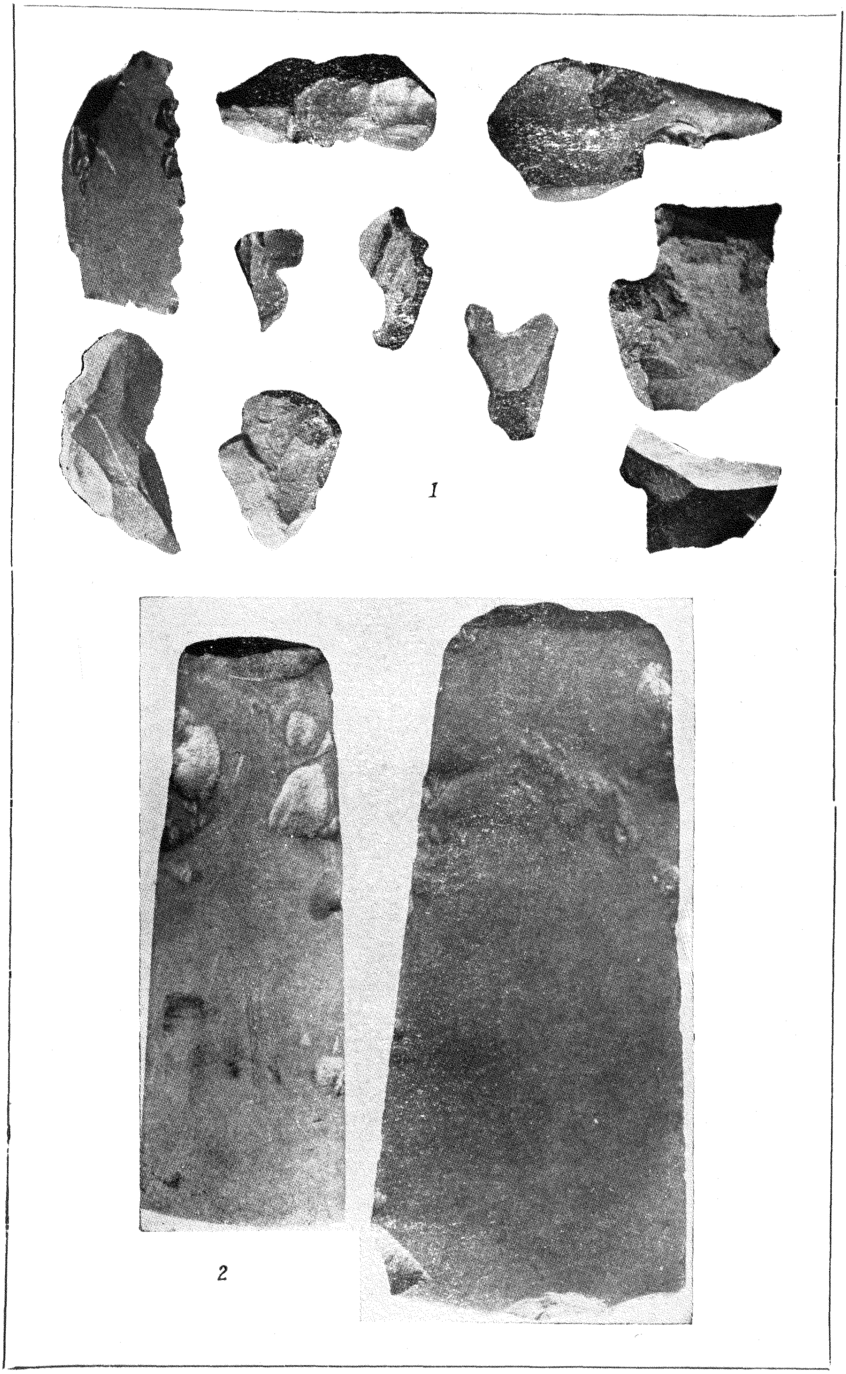

PLATE 9.

FIG. 1. NEOLITHIC FLAKED OBSIDIAN IMPLEMENTS.
2. LATE NEOLITHIC TRANSITIONAL ADZES.

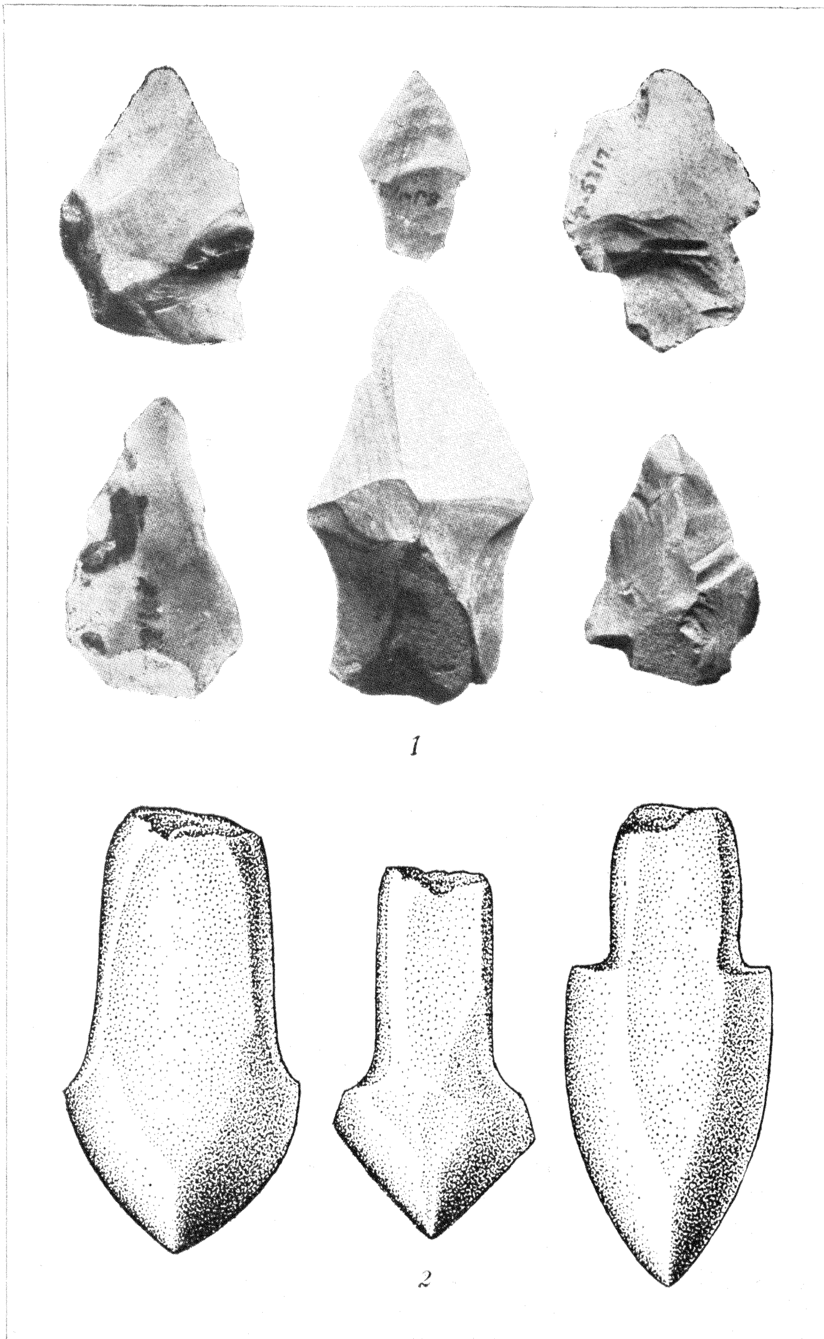

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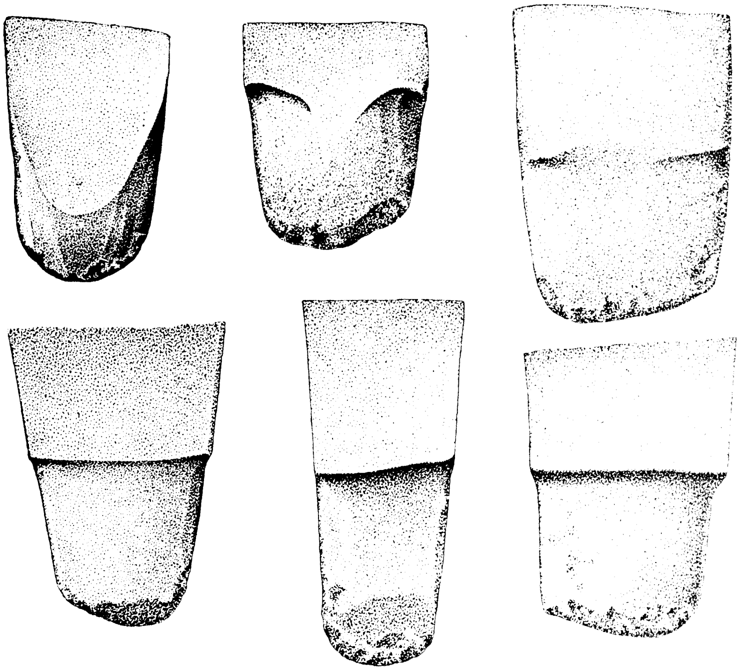
PLATE 10. NEOLITHIC ARROWPOINTS AND SPEARHEADS.



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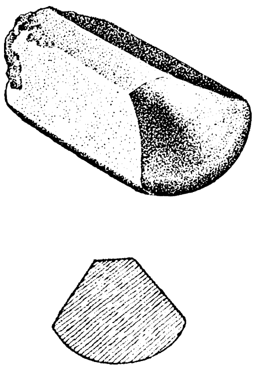

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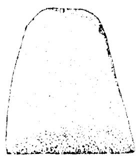

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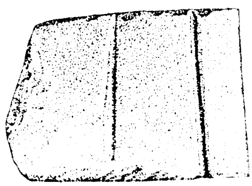

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PLATE 11. LATE NEOLITHIC STEPPED ADZES AND OTHER TOOLS.

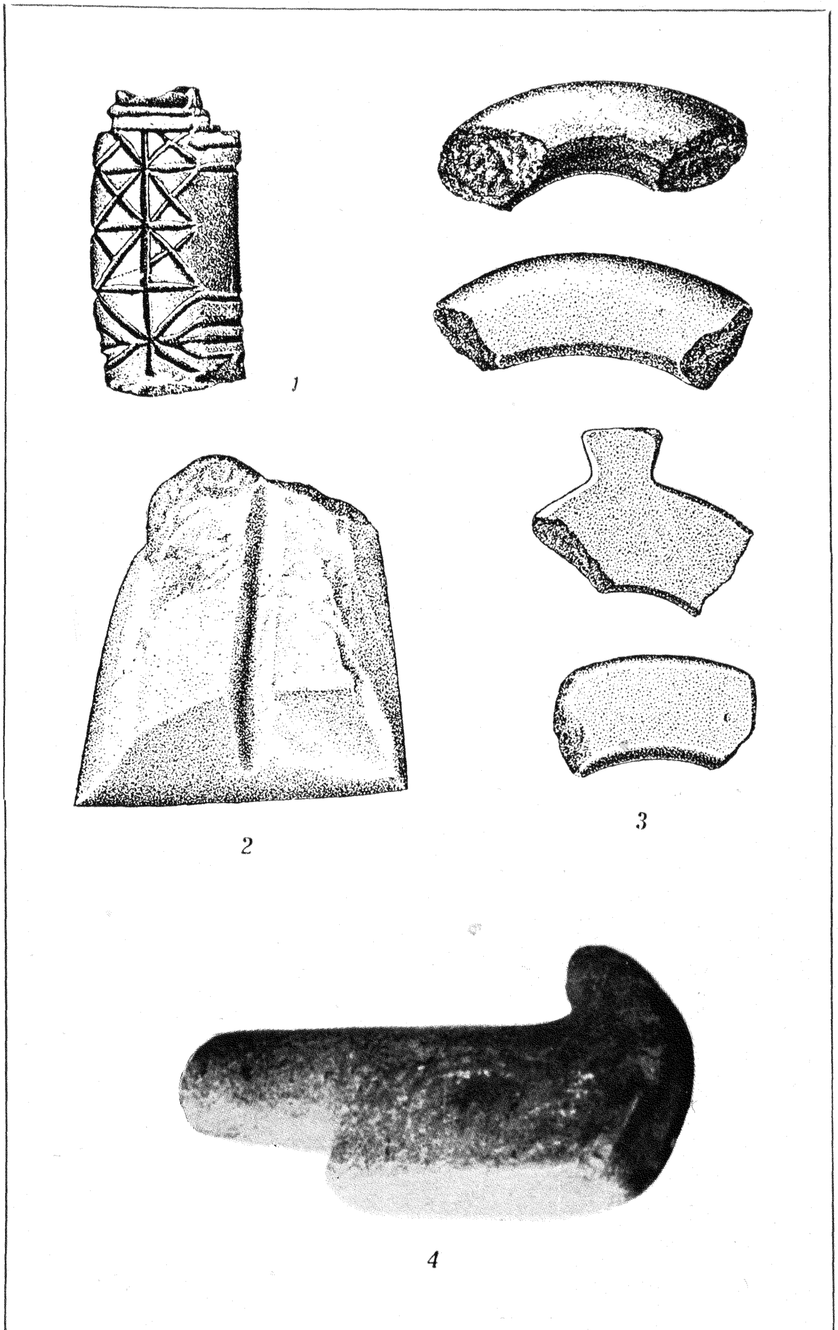
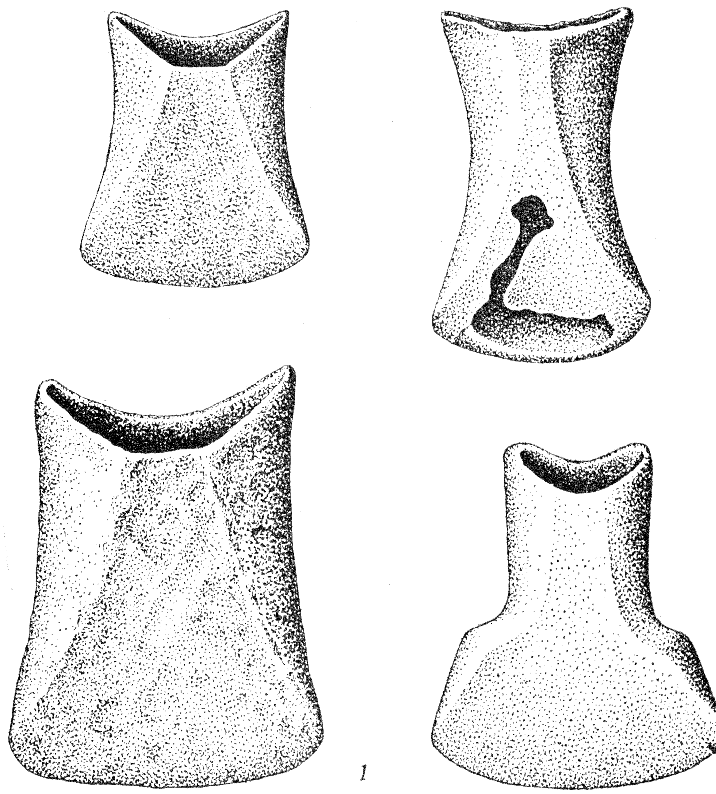


PLATE 12. LATE NEOLITHIC JADE JEWELRY AND BARKCLOTH PRINTERS AND BEATERS.



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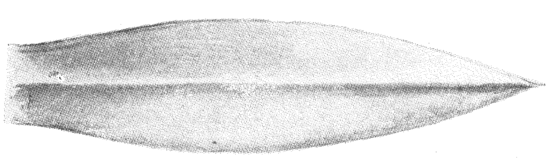

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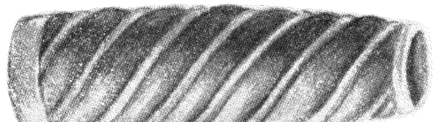

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PLATE 13. BRONZE-AGE ARTIFACTS.

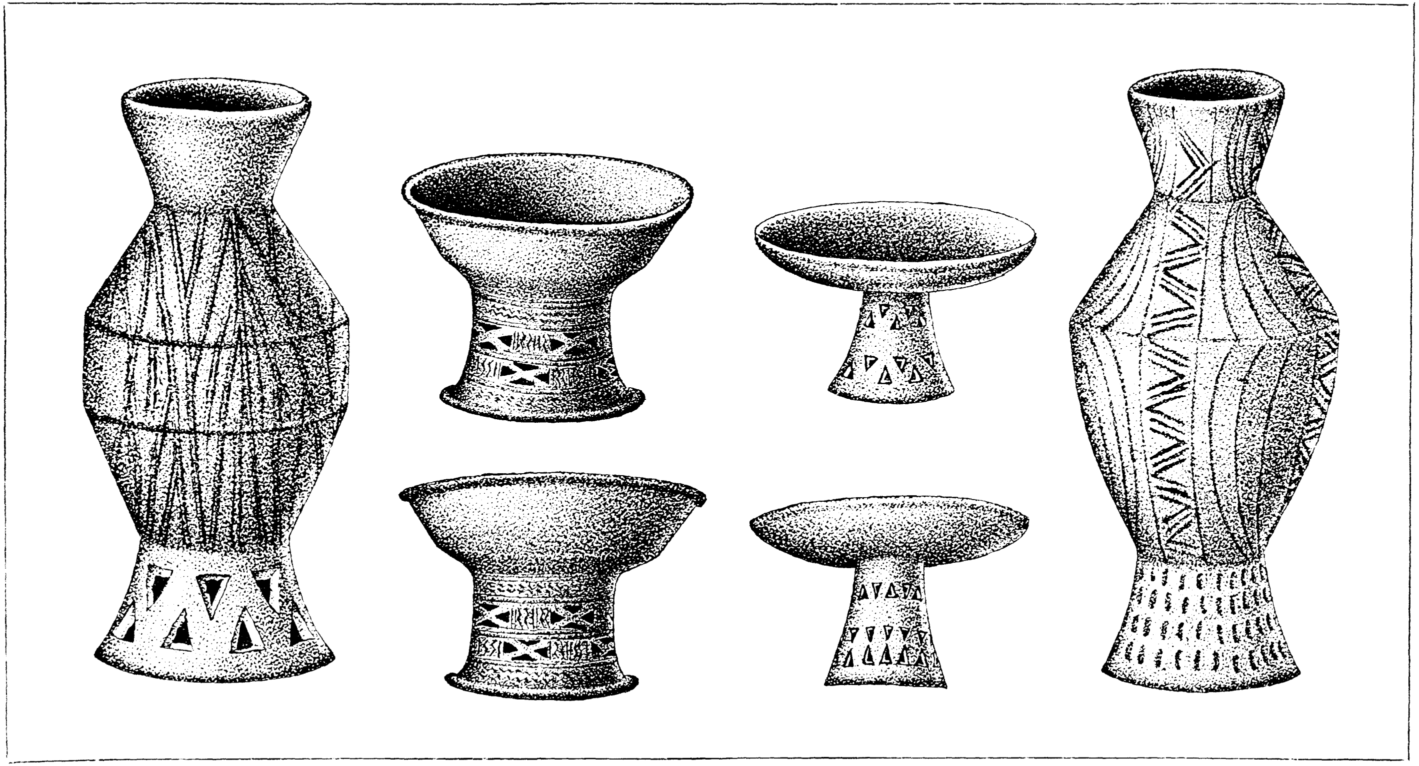
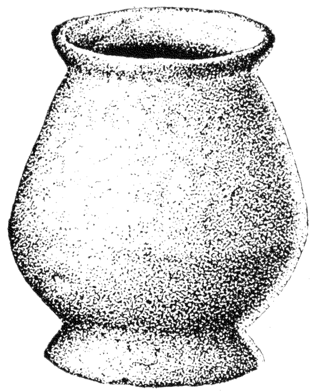


PLATE 14. POTTERY OF THE EARLY IRON AGE.



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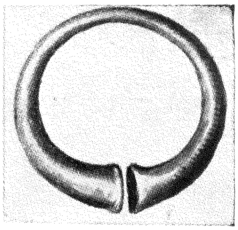

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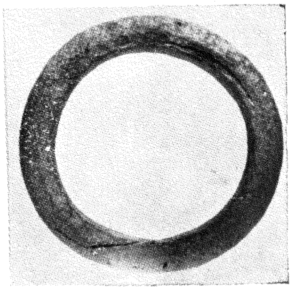

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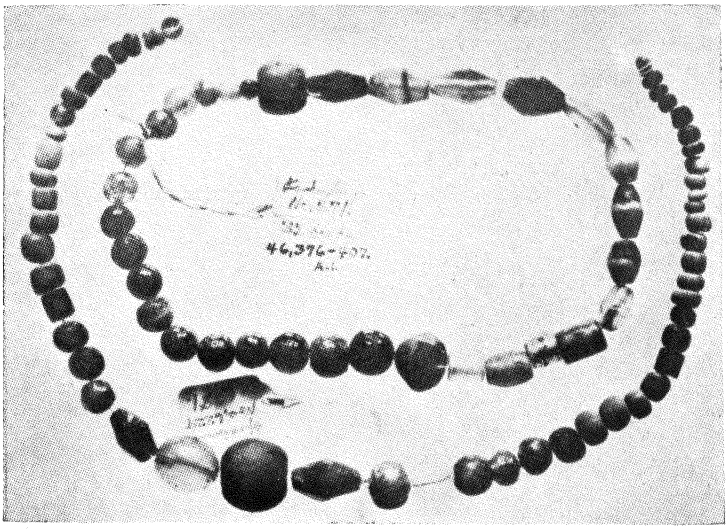

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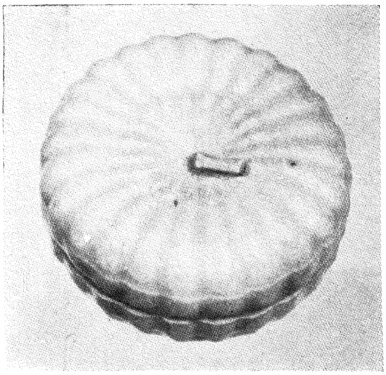
PLATE 15. IRON-AGE GRAVE JEWELRY AND POTTERY OBJECTS.



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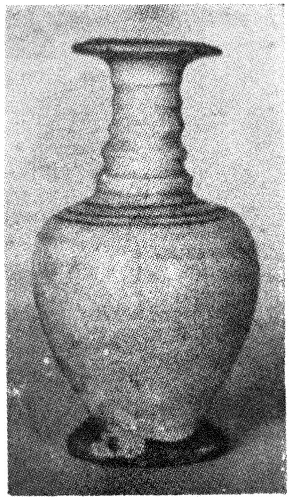

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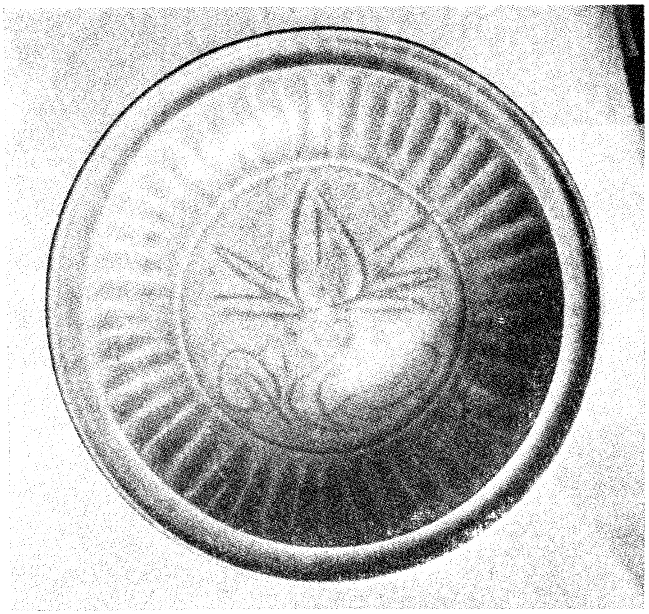
PLATE 16. LATE TANG AND EARLY SUNG WARES—9TH TO 11TH CENTURIES.



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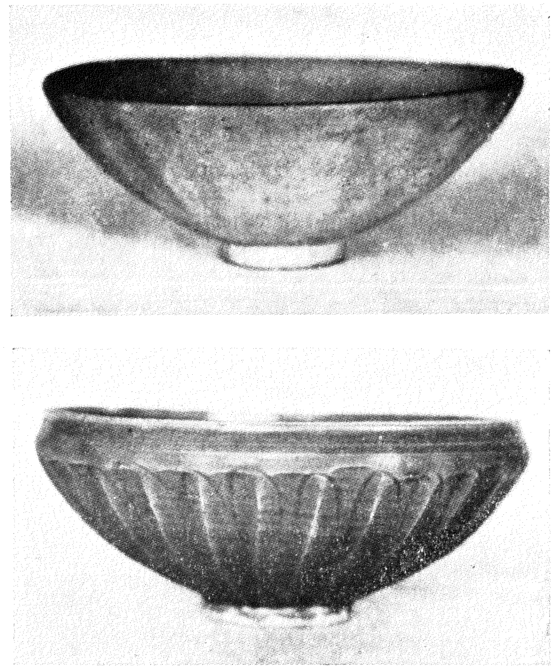

2

LATE 17. TYPICAL LUNGCHUAN SUNG CELADONS OF THE 11TH AND 12TH CENTURIES.

1

2

PLATE 18. SAWANKHALOK BLACK-GLAZED AND CELADON PIECES OF 13TH- AND 14TH-CENTURY TYPES.

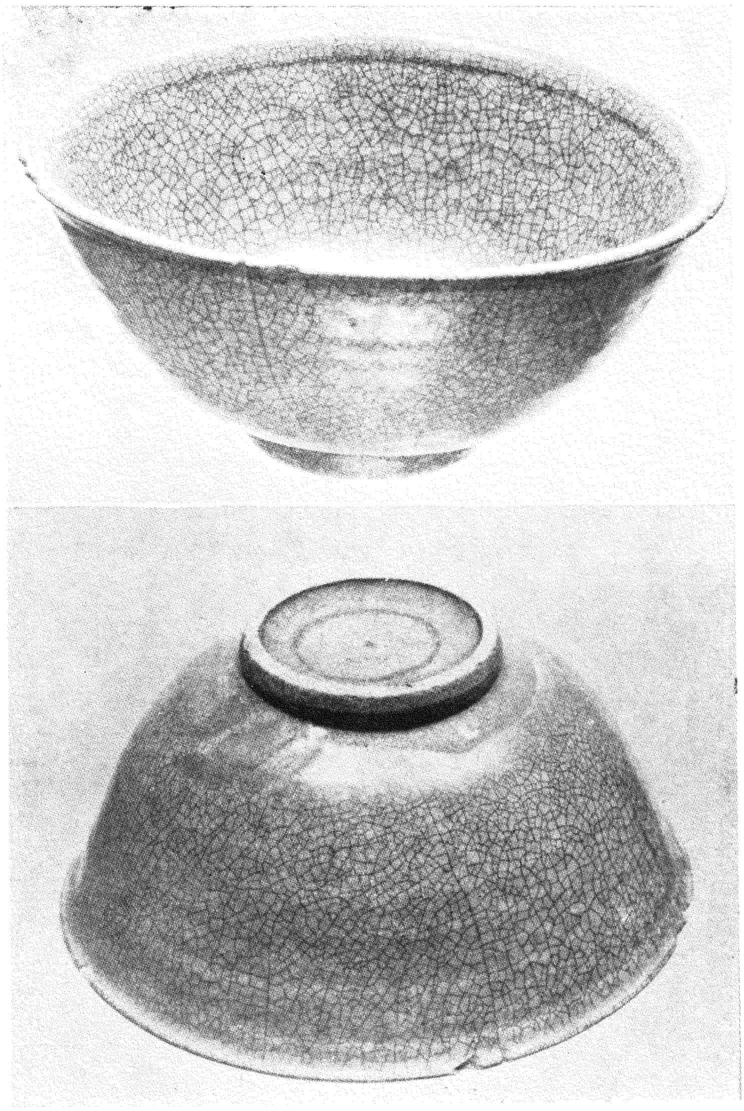

PLATE 19. MEDIUM-LARGE SAWANKHALOK CELADON BOWL WITH DARK-GREEN CRACKLED GLAZE.

1

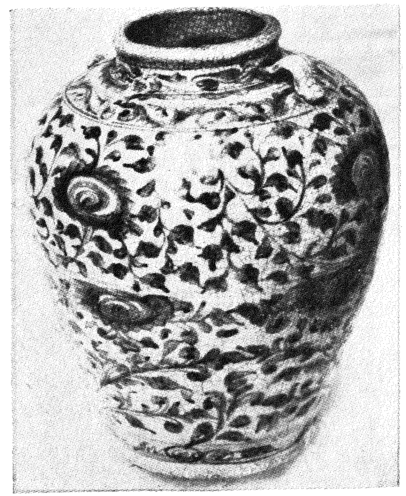

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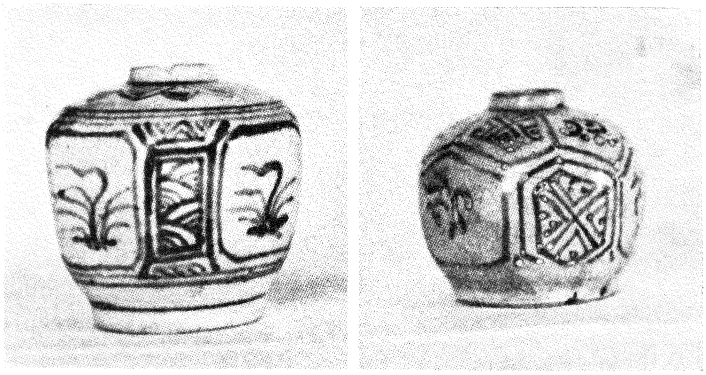
PLATE 20. TYPICAL LARGE MING JARS.



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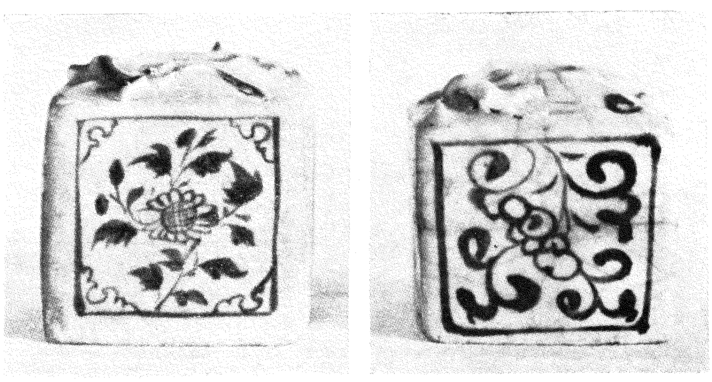


2

PLATE 21.

FIG. 1. TWO TYPICAL JARLETS OF THE "RED-BOTTOMED" GROUP.
2. BEGINNING TYPE OF EARLY MING BLUE-AND-WHITE WARE.

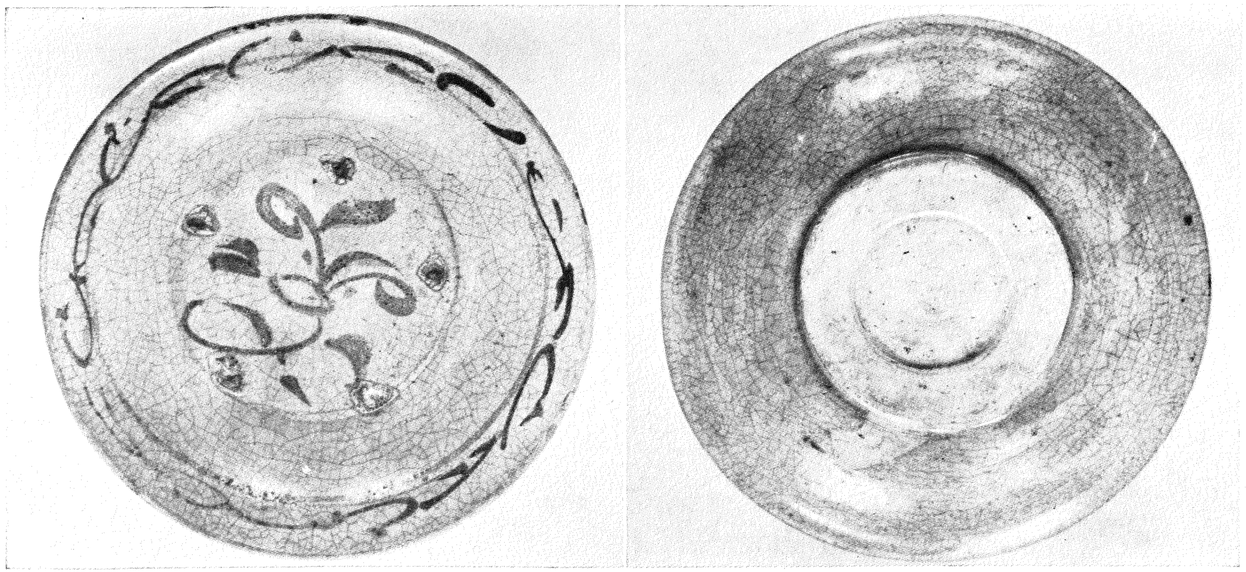


PLATE 22. A SPECIAL TYPE OF INDO-CHINA BLACK-AND-WHITE WARE OF THE "RED-BOTTOMED" GROUP.

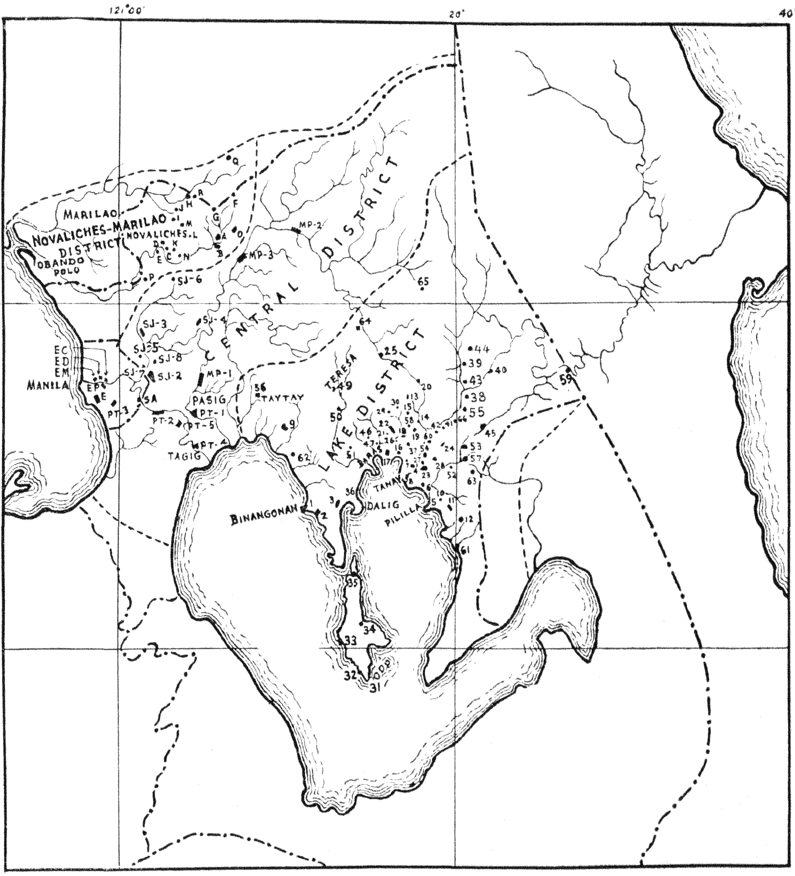
MAP OF RIZAL PROVINCE

ARCHAEOLOGICAL SURVEY

By

H. OTLEY BEYER

1926–1929



LEGEND

106 Sites, distributed as follows:

I. NOVALICHES-MARILAO DISTRICT

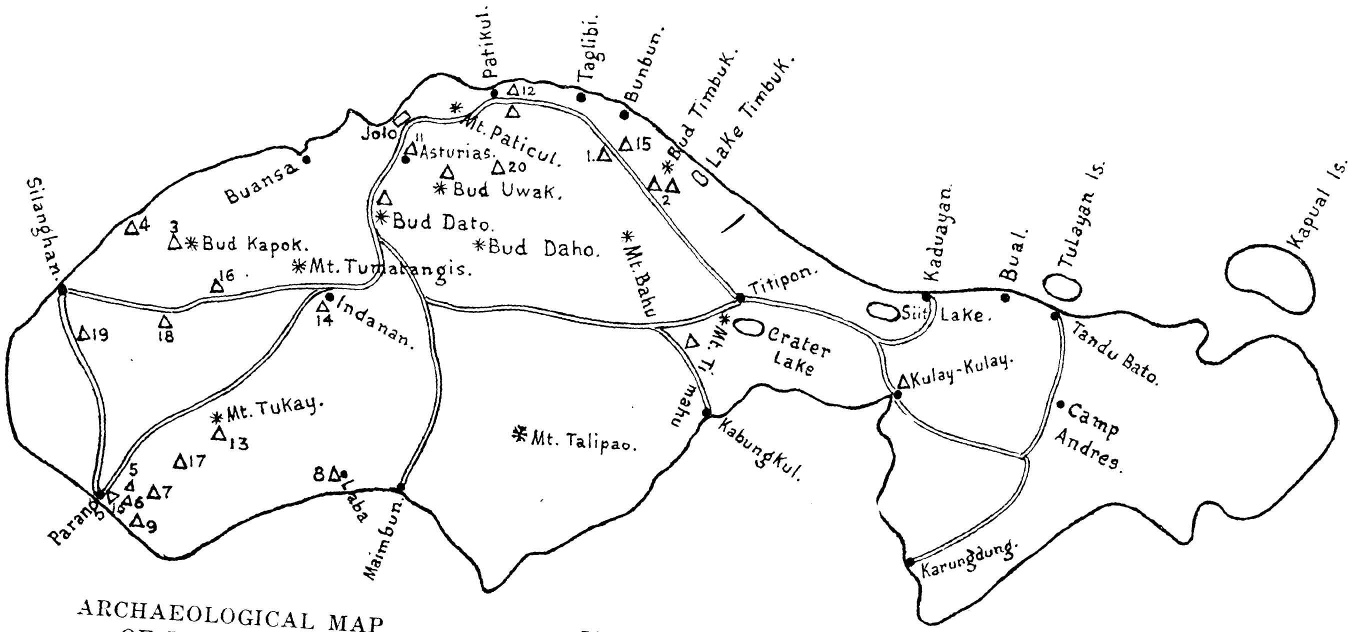
Sites A to R.

II. CENTRAL DISTRICT

Sites SJ-1 to SJ-8.
Sites E, EC, ED, EM, EP.
Site SA.
Sites PT-1 to PT-5.
Sites MP-1 to MP-3.

III. LAKE DISTRICT

Sites 1 to 66.



ARCHAEOLOGICAL MAP
OF JOLO ISLAND

By F. G. ROTH, H. O. BEYER, and
M. MA. SANTIAGO

MANILA
JANUARY, 1910

LEGEND

= Roads.
△ Archaeological Sites.

Site List:

1. Sapa Lawakan.
2. Bud Tumbuk.
3. Bud Kapok.
4. Timahu.
5. Luas.
6. Labuan.
7. Laum Sua.
8. Bud Laba.
9. Tubig Jaikah.
10. Parang Barracks.
11. Asturias Barracks.
12. Patikul Sites.
13. Bud Tukay.
14. Indanan.
15. Bud Makam.
16. Lañgpas.
17. Linoho.
18. Tubig Dakula.
19. Piahan
20. Takas.

INDEX

[New names and new combinations are printed in *italics*.]

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